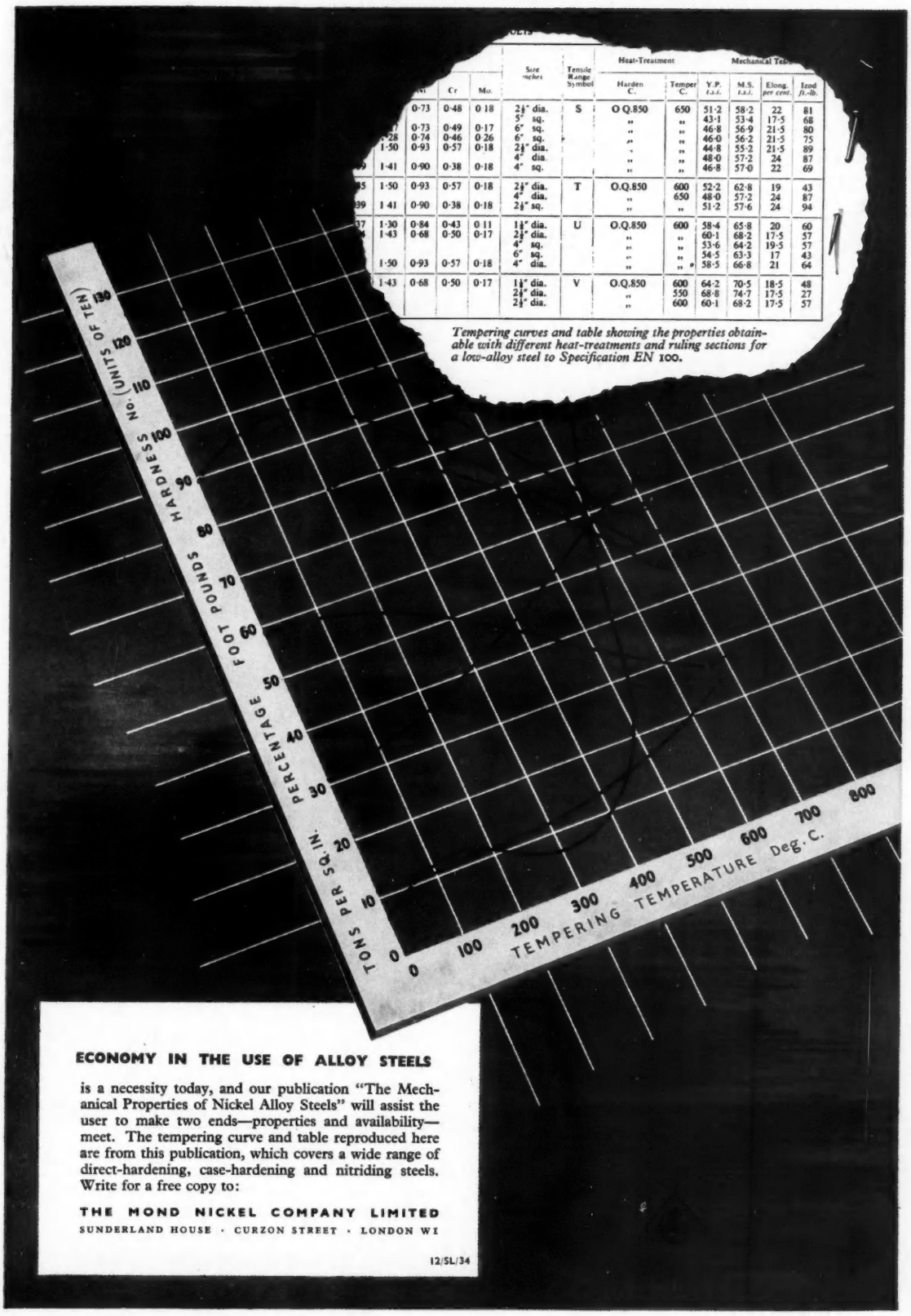
The Engineer

JUNE 19, 1953 28, ESSEX ST., STRAND, LONDON, W.C.2. TWO SHILLINGS

UNIVERSITY OF MICHIGAN
JUL 2 1953
ENGINEERING LIBRARY

	Cr	Mo	Size inches	Tensile Range Symbol	Heat-Treatment: Harden C.	Temper C.	Mechanical Test: Y.P. t.s.i.	M.S. t.s.i.	Elong. per cent.	Izod ft.-lb.
	0·73	0·48	0·18	2½" dia.	S	O.Q.850	650	51·2	58·2	22	81
				5" sq.		,,	,,	43·1	53·4	17·5	68
	0·73	0·49	0·17	6" sq.		,,	,,	46·8	56·9	21·5	80
	0·74	0·46	0·26	6" sq.		,,	,,	46·0	56·2	21·5	75
	0·93	0·57	0·18	2½" dia.		,,	,,	44·8	55·2	21·5	89
				4" dia.		,,	,,	48·0	57·2	24	87
1·41	0·90	0·38	0·18	4" sq.		,,	,,	46·8	57·0	22	69
1·50	0·93	0·57	0·18	2½" dia.	T	O.Q.850	600	52·2	62·8	19	43
				4" dia.		,,	650	48·0	57·2	24	87
1·41	0·90	0·38	0·18	2½" sq.		,,	,,	51·2	57·6	24	94
1·30	0·84	0·43	0·11	1½" dia.	U	O.Q.850	600	58·4	65·8	20	60
1·43	0·68	0·50	0·17	2½" dia.		,,	,,	60·1	68·2	17·5	57
				4" sq.		,,	,,	53·6	64·2	19·5	57
				6" sq.		,,	,,	54·5	63·3	17	43
1·50	0·93	0·57	0·18	4" dia.		,,	,,	58·5	66·8	21	64
1·43	0·68	0·50	0·17	1½" dia.	V	O.Q.850	600	64·2	70·5	18·5	48
				2½" dia.		,,	550	68·8	74·7	17·5	27
				2½" dia.		,,	600	60·1	68·2	17·5	57

Tempering curves and table showing the properties obtainable with different heat-treatments and ruling sections for a low-alloy steel to Specification EN 100.



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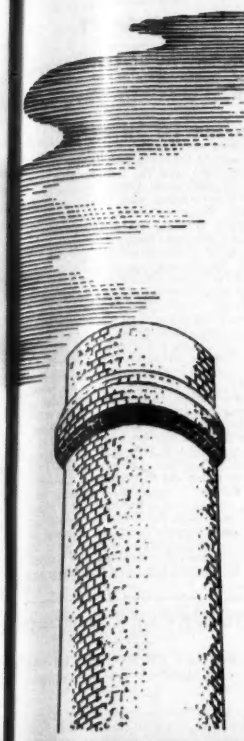

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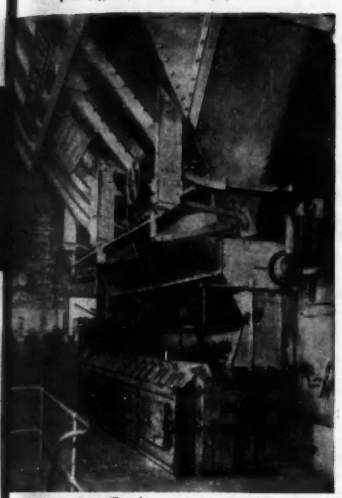

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NOTICE TO READERS

All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

SUBSCRIPTIONS

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WORDING OF ADVERTISEMENTS: Approximately the first 25 letters of each advertisement are set in heavy type. Advertisers are therefore advised to begin their advertisements with the words they want emphasized.

Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

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PUBLIC APPOINTMENTS

UNIVERSITY OF SOUTHAMPTON

DEPARTMENT OF CIVIL ENGINEERING

LECTURER

Applications are invited for the post of LECTURER, tenable from 1st September, 1953. A good Honours Degree is required and practical or research experience in civil engineering hydraulics would be an advantage. Salary scale, Lecturer, £550 by £50 to £1100, with a " bar " at £800, with F.S.S.U. and children's allowance benefits. An appointment at or near the " bar " is contemplated.—Further particulars may be obtained from the Secretary and Registrar, The University, Southampton. E9040

CORPORATION OF GLASGOW

STOW COLLEGE, SCHOOL OF ENGINEERING

SENIOR ASSISTANT, MACHINE SHOP PRACTICE

Applications are invited for the post of SENIOR ASSISTANT, MACHINE SHOP PRACTICE. Applicants must not be more than 45 years of age on 1st August 1953, or, if in the Corporation service, not more than 50 years of age.

The essential qualifications are : regular training through apprenticeship as turner and machinist with subsequent workshop experience. A recognised Degree, Diploma or Certificate and teaching experience will be additional qualifications. Duties include a measure of evening class teaching and/or supervision.

Salary is the appropriate Day Continuation Class Scale plus £140 responsibility payment, with placing according to experience.

Application forms obtainable from the Director of Education, 129, Bath Street, Glasgow, C.2, to be returned by 30th June, 1953.

H. STEWART MACKINTOSH,
E9038 Director of Education.

GLAMORGAN EDUCATION COMMITTEE

GLAMORGAN TECHNICAL COLLEGE, TREFOREST

LECTURER IN PRODUCTION ENGINEERING

Required, for September, 1953, at the Glamorgan Technical College, Treforest, LECTURER in PRODUCTION ENGINEERING. Candidates must possess a Degree in Mechanical Engineering or an equivalent qualification, and should preferably be Corporate Members of the Institute of Production Engineers. Experience of productive engineering, together with teaching experience in a Technical College, are essential qualifications.

Salary in accordance with the Burnham Report, 1951, on Salaries for Teachers in Establishments for Further Education. Application forms, obtainable from the undersigned on receipt of a stamped, addressed foolscap envelope, must be returned by 27th June, 1953. Canvassing will disqualify.

EMLYN STEPHENS,
Director of Education.
County Hall, Cardiff. E9067

COLLEGE OF TECHNOLOGY, BIRMINGHAM

HEAD OF DEPARTMENT OF MECHANICAL ENGINEERING

REVISED ADVERTISEMENT

Applications are invited for the above post, which is to be filled as soon as possible. Applicants should possess, in addition to appropriate academic and teaching experience, also industrial and research experience.

Salary will be £1490 by £25 to £1790, and the post will be graded in accordance with the Burnham (Further Education) Report as a Grade V Headship.

Forms of application and details and duties of the post may be obtained from the Registrar, College of Technology, Suffolk Street, Birmingham, 1.

Closing date for applications is 20th July, 1953.

C. McCAW,
E9133 Clerk to the Governing Body.

LINDSEY COUNTY COUNCIL EDUCATION COMMITTEE

GAINSBOROUGH COUNTY TECHNICAL COLLEGE

APPOINTMENT OF PRINCIPAL

Applications are invited for the post of PRINCIPAL of the Gainsborough Technical College. Candidates should possess a University Degree and good qualifications in Engineering. An interest in the development of other forms of further education will be an additional recommendation. Salary, subject to the approval of the Ministry of Education, will be at the rate of £1040, rising by annual increments of £50 to a maximum of £1290.

Further particulars and forms of application may be obtained from the undersigned, to whom completed applications must be returned not later than two weeks after the publication of this advertisement.

F. J. BIRKBECK,
Director of Education.
County Offices,
Lincoln. E9096

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

HEAD OF THE DEPARTMENT OF CIVIL ENGINEERING AND BUILDING

The Governing Body invites applications for the post of HEAD of the DEPARTMENT of CIVIL ENGINEERING and BUILDING. Duties will commence on 1st September, 1953, or as soon as possible thereafter.

Candidates should hold a Degree in Civil Engineering or A.R.I.B.A. Approved experience in the building industry would be an additional recommendation. A commencing salary of up to £1040 may be paid to a suitably qualified candidate.

Further particulars and application form will be sent by the undersigned on receipt of a stamped, addressed, foolscap envelope. Last date for receipt of applications Wednesday, 1st July, 1953. Applications not on the form provided will be disregarded.

E. C. SMITH,
Principal.
8th June, 1953. E9085

PRESTON HARRIS INSTITUTE TECHNICAL COLLEGE

FULL-TIME ASSISTANT

Applications are invited for the above pos . The duties will consist chiefly of teaching in science and mathematics in the Secondary Technical School, and may include some duties in the Engineering Departments of the College.

Salary will be in accordance with the Main Burnham Scale for Secondary Schools.

Forms of application may be obtained from the undersigned, and should be completed and returned as early as possible to the Technical College, Corporation Street.

T. M. NAYLOR
E8995 Principal.

THE POLYTECHNIC,

309, REGENT STREET, W.1

MECHANICAL AND CIVIL ENGINEERING DEPARTMENT

LECTURER

Applications are invited for a full-time post as LECTURER in Mechanical Engineering.

The salary scale commences at £940 per annum, rising by annual increments of £25 to £1040 plus London allowance of £36 or £48 p.a.

Further particulars and application form, to be returned by not later than 30th June, may be obtained by sending a stamped, addressed foolscap envelope to the undersigned.

J. C. JONES,
E9069 Director of Education.

BIRKENHEAD TECHNICAL COLLEGE

LECTURER IN MECHANICAL ENGINEERING

A LECTURER in Mechanical Engineering (Strength of Materials, Theory of Machines, Theory of Structure, to H.N.C. Degree).

Salary in accordance with Burnham Technical Scales.

Application forms and further particulars from the undersigned at 63, Hamilton Square, Birkenhead, to whom applications should be returned by 11th July, 1953.

H. GLYN WILKINSON,
E9084 Director of Education.

MONMOUTHSHIRE EDUCATION COMMITTEE

THE TECHNICAL COLLEGE OF MONMOUTHSHIRE, CRUMLIN

ELECTRICIAN

ELECTRICIAN required from the 1st September next mainly on maintenance and repair work of electrical equipment at the College. Good practical experience essential ; theoretical qualifications in National or City and Guilds Certificates desirable.

Salary will be at the rate of £405 by £5 to £420 per annum.

Forms of application and further particulars obtainable from the undersigned must be returned by 4th July.

C. E. GITTINS,
County Hall, Director of Education.
Newport, Mon. E9132

WEST RIDING COUNTY COUNCIL

TODMORDEN TECHNICAL INSTITUTE

GRADE A ASSISTANT

Wanted, for 1st September next, if possible, GRADE A ASSISTANT, to teach (day and evening) S.1 and S.2 mechanical engineering subjects (with bias towards the practical side), S.1 electrical engineering, to help with the teaching of preparatory technical students and to supervise the engineering workshops.

Salary £415 by £18 to £670, with increments for graduate qualification, approved training and industrial experience.

Forms of application will be supplied, on receipt of a stamped, addressed envelope, by Dr. E. Aitken-Davies, Divisional Education Office, Hall Street, Todmorden, to whom applications should be returned within two weeks of the date of the advertisement. E9066

SURREY EDUCATION COMMITTEE

KINGSTON-ON-THAMES TECHNICAL COLLEGE
KINGSTON HALL ROAD
KINGSTON-ON-THAMES

FULL-TIME TEACHER OF MECHANICAL ENGINEERING

Applications are invited for the post of Full-Time TEACHER of Mechanical Engineering subjects for the Full-Time Diploma and Part-Time National Certificate Courses, in the Engineering Department.

Candidates should possess a Degree in Mechanical Engineering and/or an equivalent qualification, and should preferably have good experience in industry. Previous teaching experience, either full-time or part-time, will also be an added advantage.

Salary in accordance with the Burnham Technical Scale, 1951, for Assistants, Grade A (men, £415 by £18 to £670 p.a.). If the qualifications and experience of the successful candidate are sufficiently high, consideration may be given to an appointment on Grade B.

Forms of application, together with particulars of the appointment, may be obtained from the Principal, to whom they should be returned within two weeks of the appearance of this advertisement. E9138

GOVERNMENT OF QATAR (PERSIAN GULF)

ELECTRIFICATION OF DOHA

POWER STATION ENGINEER

Applications are invited for the above appointment. Candidates must have served a mechanical engineering apprenticeship and have considerable practical experience of the erection, operation and maintenance of diesel engine alternator sets and ancillary equipment, H.V. and L.V. switchgear, and be capable of training local labour. A knowledge of cable and overhead line work would be an advantage.

Salary £140 to £150 per Arabic month, according to qualifications and experience, payable in Rupees (Rs. = 1s. 6d.), and is at present free of tax.

Appointments are for a period of five years, terminable by three months' notice on either side.

Free air passages are provided for the officer and his family on first appointment, on termination of agreement and for leave to the United Kingdom.

Free quarters with heavy furnishings, water and light, and medical attention will be provided.

Leave is earned at the rate of 90 days per year of resident service and may be accumulated. Earned leave to the United Kingdom may be taken after 18 months' service.

A knowledge of Arabic would be an advantage. Applications, endorsed " Power Station Engineer—Qatar," stating age, qualifications and experience, should be forwarded within 21 days of the date of this advertisement to the undersigned, who will communicate with candidates selected for further consideration.

PREECE, CARDEW AND RIDER.
8–10, Queen Anne's Gate,
Westminster, London, S.W.1. E9147

CITY OF MANCHESTER

CITY SURVEYOR AND ENGINEER'S DEPARTMENT

CHIEF ASSISTANT ENGINEER

Applications are invited from Corporate Members of the Institution of Civil Engineers/Municipal Engineers/Constructional Engineers or Mechanical Engineers for the appointment on the permanent staff of a CHIEF ASSISTANT ENGINEER (within the salary range of £980/£1100 per annum).

Applicants should have had experience in reinforced concrete design, the application of hydraulics and design of large sewage disposal works.

The person appointed will be engaged on the design of the proposed Davyhulme Sewage Works Extension, which will in total cost more than Two Million Pounds. The works will include the extensions of the activated sludge plants with a capacity of up to 47 million gallons per day, alterations and mechanisation of the sedimentation tanks, design and construction of detritus tanks and secondary settling tanks, installation of sludge digestion plant and of ancillary works connected therewith.

Applicants should forward particulars of age, education, qualifications and experience, together with the names of three persons to whom reference can be made, to the Town Clerk, Town Hall, Manchester, not later than 1st July, 1953. Canvassing is prohibited. E9140

FULBOURN AND RIVERSFIELD GROUP HOSPITAL MANAGEMENT COMMITTEE

FULBOURN (MENTAL) HOSPITAL

ASSISTANT ENGINEER

Applications are invited for the post of ASSISTANT ENGINEER at Fulbourn (Mental) Hospital. The candidates must have a sound knowledge of hospital engineering requirements, including steam boilers, heating and hot water services, laundry machinery and electrical equipment, and should hold an Ordinary National Certificate in Mechanical Engineering or an equivalent qualification. The successful candidate will work under the direction of the Engineer-in-Charge.

Salary will be on the scale £425 by £15 to £500, Whitley Council conditions of service. A house is available at a moderate rent.

Applications, stating age, experience and qualifications, together with the names of two referees, should be sent to the Secretary, Fulbourn Hospital, Fulbourn, Cambs, by the 6th July, 1953. E9139

ADMIRALTY

ROYAL NAVAL SCIENTIFIC SERVIC

ENGINEERS AND PHYSICISTS

ENGINEERS and PHYSICISTS (partic with electronics) required for appointments Senior Scientific Officer and Scientific Officer (Ref. A246/52A), and (b) Experimental Offic Assistant Experimental Officer grades (Ref. 52A) in experimental establishments in Lo Portsmouth, Weymouth areas, and Scotland. dates, British subjects, for (a) must possess Fi Second Class Honours Degree in Physics or Engi ing, or high professional attainments, and Corporate Membership of appropriate Profess Institution with suitable experience and respo bility, and for (b) should possess one of the follo qualifications : University Degree in Science, E neering or Mathematics ; Graduate Membe of appropriate Professional Institution ; Hi National Certificate ; Final Certificate of Free Grouped Course in relevant subject at City Guilds of London Institute or comparable institut Higher School Certificate with Mathematics Science as principal subject or equivalent quali tion. S.S.O's at least 26 years of age with at three years' approved experience, London s (men) £812–£1022 per annum ; S.O.'s at leas years, £440–£707 ; E.O.'s at least 26 years, £838 ; A.E.O.'s at least 17½ years, £274–£601. for women and posts in provinces somewhat lo Starting salaries above minima may be gra according to age and experience. All appointm unestablished (with F.S.S.U. for S.S.O. and S but with some opportunities to compete for e lished posts.—Application forms from M.L.N Technical and Scientific Register (K) Almack Ho 26, King Street, London, S.W.1, quoting appropr reference. E905

CIVIL SERVICE COMMISSION

PROFESSIONAL ENGINEERS IN VARIO GOVERNMENT DEPARTMENTS

The Civil Service Commissioners invite app tions for about 130 PENSIONABLE POSTS wide variety of mechanical and electrical engine duties. Applications may be accepted up to September, 1953, but an earlier closing date m announced.

Candidates must be under 35 on 1st January, with extension for regular service in H.M. Forces up to two years for permanent civil service. Fo Post Office they must be at least 21, for the Min of Supply and Ministry of Civil Aviation at leas and for all other departments at least 25 on that

Generally a candidate must possess a Univ Degree in Engineering or be a Corporate Memb one of the professional institutions—Mecha Engineers, Electrical Engineers, or Civil Engine or have passes in, or exemption from, Section and B of the corresponding Associate Member Examinations. Exceptionally candidates of high fessional attainment, but without the specified qu cations, may be admitted. For some posts Asso Fellowship of the Royal Aeronautical Society o Honours Degree in Physics will be accepted.

Inclusive salary scale (men in London) £628 (at 25) to £970. Starting salary according to age a £875 at 34. Candidates entering below age 25 start at salaries varying from £429 at age 21 to £5 age 24. Prospects of promotion. Salaries of higher grades are £970–£1280 and £1331–£1 Somewhat lower for women and in the provinc

Further particulars and application forms f Civil Service Commission, Scientific Branch, Trin House, Old Burlington Street, London, W.1, quo No. S85/53. E905

GOVERNMENT OF KUWAIT

DIESEL POWER STATION SHIFT ENGINEERS

DIESEL POWER STATION SHIFT EN NEERS required for service with the Governm of Kuwait, Persian Gulf. Applicants, prefer not more than 35 years of age, should have s technical qualifications, together with good experi in the operation and maintenance of diesel eng and generators, and also sufficient electrical kn ledge of an A.C. distribution system to be abl operate the power plant in the station efficie Steam power plant operation experience would advantageous, as at a later date a steam po station will be operating and it might be possibl transfer the services of the Diesel Power Sta Shift Engineers over to the steam station. The star consolidated salary offered is at the rate of £150 £1600 per annum, according to experience. furnished quarters and free medical attention provided, or an allowance in lieu thereof. The year will be probationary and, if satisfactory, le leave will be granted at the end of three years' c plete service. Married accommodation cannot promised within one year.—Applications, stating and giving full details of qualifications and exp ence, should, in the first instance, be addressed to Secretary, Ewbank and Partners, Limited, 10 Grosvenor Place, London, S.W.1. E90

BRITISH ELECTRICITY AUTHORI

NORTH WESTERN DIVISION

MAINTENANCE ENGINEER (MECHANICAL)

British Electricity Authority, North We Division, requires MAINTENANCE ENGINE (MECHANICAL) at Back o' th' Bank Genera Station, Bolton, Lancs. Salary £787/£818 per ann A.M.I.Mech.E. or equivalent preferred. Experi of operation and maintenance of power plan advantage.—Apply, quoting Vacancy No. 86/5 Establishments Officer, British Electricity Ha 825, Wilmslow Road, Manchester, 20, before July E90

THE ENGINEER

JUNE 19, 1953

Expenditure on Rearmament

THE seventh report of the Select Committee on Estimates, which was published by H.M. Stationery Office last week, deals with certain aspects of expenditure on rearmament, following an examination of the estimates of the Service Departments and of the Ministries of Supply and Defence. The committee has made various recommendations in its report. One of them is that the Ministries of Supply and Defence and the Service Departments should examine the possibility of greater co-operation between the Western Allies so that each country could produce, at a reduced cost per aircraft, a more limited range but greater numbers of specialised aircraft for the benefit of all the allies, provided that the proper balance of aircraft manufactured in this country is fully maintained. Another recommendation is that the plan for the large testing-frame at the Naval Construction Research Establishment at Rosyth should be completed as soon as the requisite funds can be made available, and that every facility should be given by the Service Departments to test the results of the Establishment's researches in service conditions and in any future atomic test. The select committee has also urged that every assistance should be given to the Radar Research and Development Establishment and the Telecommunication Research Establishment of the Ministry of Supply, and to the Admiralty Signal and Radar Establishment to secure and maintain an adequate staff of scientists in order to preserve the all important factor of continuity in research. In putting forward this recommendation, the committee says "that whatever general economies may result from the changed emphasis in the time-table of the defence programme, it would be false economy to extend them to these establishments." A final recommendation made in the report is that the Ministry of Supply should consult with the machine tool industry to discover how to remedy our complete dependence on foreign suppliers for certain kinds of machine tools.

The Royal Aeronautical Society's Garden Party

THE annual garden party of the Royal Aeronautical Society was held last Sunday at Astwick Manor, Hatfield aerodrome, a facility which was offered by Sir Geoffrey de Havilland for the occasion. As this year marks the fiftieth anniversary of the first four powered flights made by the Wright Brothers, in December 1903, the evolution of the flying machine was very fittingly chosen as the theme for that event. In the programme itself were reproduced cuttings taken from the world's press, in which the evolution was reported and many interesting items help to recall the enthusiasm, the prejudice and the rivalry which surrounded aviation particularly during that first momentous phase. A contrast of veteran aircraft was evident in the first part of the flying display when three Hawker aircraft, the "Hurricane" and the "Hart" and "Tomtit" biplanes flew low overhead in close formation, these latter machines being of early 1930 vintage. It was, however, at the end of the flying programme that the amazing development of the aeroplane was most vividly portrayed. At this stage of the display a section of the parking area was cleared, down which two aircraft from the Shuttleworth collection, a Deperdussin monoplane, built in 1910, and a Blackburn monoplane of 1912 flew in rather an oscillatory manner at a height of 2ft or 3ft., these frail but very resilient structures coming to rest some 1000 yards away. On concluding this demonstration it was announced that the Handley Page "Victor" would fly over in the course of a routine flight and many members and guests of the Society saw this crescent wing aircraft for the first time. Thus were contrasted the top speeds of about 60 m.p.h. and 600 m.p.h. and the profiles of flying machines each amongst the best of its day, the "Victor" probably developing 600 times the combined thrust of the two early craft demonstrated. In spite of a low if broken cloud base all but the American jet aircraft scheduled in the display flew. The flying demonstration included several of the well-known military aircraft of the last war and of other civil and fighter aircraft representative of the intermediate development of the aeroplane. In addition other historic craft were displayed in the static park, and in another enclosure was a selection of aircraft engines which ranged from the early French Clerget rotary engines and the British in-line Green engines to the Bristol coupled "Proteus" propeller turbine and the De Havilland "Goblin" jet turbine.

Expenditure on Roads

AT the annual general meeting of the British Road Federation, Lord Sandhurst, in his chairman's speech, said that he was firmly convinced that the low level of Government expenditure on road maintenance and development was uneconomic, a danger to public safety and contrary to the best interests of the country from both a trading and production point of view. Successive Governments, he said, had failed to deal with the situation, and there had been no sign of any change of outlook by the present administration. Only by spending money to improve present roads and build new ones, he continued, could the movement of traffic be improved; the fact stood out that Britain had the slowest traffic in Europe. In a memorandum of evidence submitted to the Select Committee on Estimates, Lord Sandhurst went on, the British Road Federation had urged the adopton of a fixed road policy with reasonable assurance over a term of years as to the amount of money which would be made available for the maintenance of roads, the improvement of existing roads, and the construction of new roads. Revenue from motor taxation increased year by year, he argued, whilst the proportion made available for road-work decreased. In the current year, Lord Sandhurst pointed out, the money available for maintenance had been cut by over 4 per cent. Having regard to the increased costs of wages and materials, that meant that in some counties roadworks generally would be reduced by as much as 15 per cent and surfacing by as much as 25 per cent. He could not understand how the Select Committee came to the conclusion that it had received no convincing evidence of the deterioration of the roads, for, in his opinion, the evidence contained in the Committee's report, which he had read most meticulously, seemed to emphasise the opposite view. Lord Sandhurst then commented upon a statement made by Mr. Gurney Braithwaite, Parliamentary Secretary to the Ministry of Transport, to the effect that safety on the roads in the last analysis was not achieved by large capital expenditure, but by the exercise of intelligence, road knowledge and courtesy. Few would dispute the need for the last three elements, Lord Sandhurst said, but expert-informed opinion certainly did not agree with Mr. Braithwaite's remarks on capital expenditure. Until more money was spent on road improvements such as the removal of "black spots" and road development generally, Lord Sandhurst went on, there would be no significant impact on the present toll of human life. The root of the whole trouble, he contended, was that no post-war Government had had a road policy at all. What was required was a new approach to the whole matter; the Government must be prepared, he emphasised, to act with imagination if the maximum efficiency were to be obtained from road transport in this new Elizabethan era.

Council Meeting of the I.C.A.O.

THE seventh assembly of the International Civil Aviation Organisation opened its session in the Royal Pavilion, Brighton, Sussex, on Tuesday, June 16th. It is the first full-scale session of the I.C.A.O. Assembly to be held since 1950 and is attended by the delegations of fifty-nine member-countries. The I.C.A.O. Council is a permanent body responsible to the Assembly and elected by the Assembly for a three-year term. A new Council will be elected this year. The twenty-one members of the permanent Council of I.C.A.O. are not only delegates of their own countries; they are, both in theory and in practice, guardians of the interests of fifty-nine States. In electing States to the Council, due account is taken of the volume of air transport or facilities provided for international air navigation and of the need for an adequate representation of the major geographical areas of the world. The main functions of the Council are many. It aims to achieve the adoption of international standards and to recommend practices for world-wide implementation, and to convene economic, technical and legal meetings in the various regions of the world. It also requests, collects, examines and publishes information relating to the advancement of air navigation and the operation of international services, and conducts researches into all aspects of air transport and air navigation which are of international importance. The continuing nature of the work of Council members provides them with an international understanding of problems such as could not be expected of delegates sent from time to time to short meetings who are required to abide closely by strict, although temporary, instructions. Members of the Council do not simply express the views of their respective Governments; they seek in common, either at the conference table or in private conversations, solutions which will be acceptable, if not always to everyone, at least to the majority of the countries concerned.

Developments in the Use of Rubber

THE British Rubber Development Board and its research unit, Rubber Technical Developments, Ltd., have now published their annual reports for 1952. On the occasion of the Board's annual meeting last week, the chairman, Mr. H. B. Egmont Hake, reviewed the progress made during the year, and commented upon the improvement of conditions in Malaya. He said that the International Rubber Study Group, which had been examining means of expanding world consumption of rubber, had expressed the opinion that the use of rubber in roads was one of the most important potential outlets, but its full development was a matter for further intensive study. Recent work on rubberised asphalt had disclosed a variety of potentially new uses, Mr. Hake continued. Amongst the work undertaken by the research company in 1952, technical work on the production of vapour-permeable proofed fabrics was successfully concluded. The manufacture of oxidised and depolymerised rubbers and their applications to the production of fluid rubber compositions were carried to the stage where details could be published. Other projects which were pursued included the production of new types of flooring containing rubber, latex processes, and the preparation of rubber and synthetic polymer mixtures and compounds.

The Excavation of Rock and Silt from Watercourses by Blasting

By R. HASLAM, B.Sc., A.M.I.Min.E., and J. HANCOCK, M.Sc., F.G.S., M.I.Min.E.

No. II—(*Concluded from page 827, June 12th*)

During recent years increasing quantities of explosives have been used in the excavation of rock and the removal of sand and other similar deposits from watercourses, situated at various points around the coastline of the British Isles In this article an effort has been made to review the operations which have already been carried out and to discuss the results obtained, in the hope that this information will be of assistance in similar future projects.

Removal of Sand and Silt from Watercourses

FREQUENTLY trouble is experienced with rivers and outfall channels becoming silted up, which ultimately might lead to flooding or even cause the water flow to change direction. Explosives are now being used more and more in the removal of such deposits and are particularly attractive in situations where it is difficult to manœuvre with mechanical equipment such as draglines.

The normal procedure is to blast a single row of holes along the centre line of the length of channel involved. The flow of water is thus concentrated in the trench produced and its action tends to scour away the silt remaining on each side. Subsequently any further widening can be accomplished by firing further explosive charges. It is desirable that if possible a quantity of water should be accumulated upstream behind a sluice gate or other similar barrier. This water should be released immediately after blasting and the surge of water produced can be most effective in scouring away the material disturbed by blasting.

Fig. 3—Loading Tube and Punch

It is desirable at this stage to consider the various methods of placing the explosive charges in the sand or silt. If the material under consideration is relatively firm and just shallow holes are required, it is possible that only a pointed crowbar will be required to punch the holes. This crowbar should be fitted with a T-handle to facilitate its withdrawal. If, however, as is usually the case, the holes tend to cave when the crowbar is withdrawn, then a special loading device will have to be employed. Such a device can be seen in use in Fig. 3. This consists of a length of non-ferrous tubing fitted with a removable core. The latter, which may be of wood or metal, finishes at a point at the bottom end and is so designed that, when it is in position in the tube, the point protrudes for a distance of 3in or so. Separate lifting handles are provided for both the tube and the core.

The method of use is to push the tube and the core down into the silt to the required depth. The core is then withdrawn leaving the tube in position. The charge is then pushed down the tube to the base of the hole by means of a wooden stemming rod and finally the tube is raised, by means of the lifting handle, leaving the charge in position. If the silt is soft the holes can be punched quite readily by hand, but in some circumstances, particularly with holes exceeding 4ft in depth, it is necessary to drive the loading device into the silt with a heavy hammer or even with a small hand-operated drop hammer mounted on a light tripod. Similarly, it is sometimes necessary to use a tripod and blocks to pull out the tubes from the silt.

The dimensions of the tube and core will obviously be governed by the cartridge diameter employed and the depth of hole required. In this connection the inner diameter of the tube should exceed the cartridge diameter by $\frac{1}{4}$in to $\frac{1}{2}$in, and the length of the tube should exceed the depth of hole required by about 2ft 6in. If the loading device is to be driven into the silt by drop hammer, then due allowance should be made for this in designing the core and tube. If the silt is of a treacherous nature, it is desirable to have wooden duckboards available ; these will provide a relatively firm footing for the operators. Duckboards can be seen in use in Fig. 3. In charging the holes it is desirable that the cartridge size adopted should be such that only one cartridge is required per hole.

Three methods of initiating the charges can be employed, namely :

(1) *Electrically.*—Each charge can be primed with an electric detonator, the detonators then being connected in series and the blast fired with a multi-shot exploder.

(2) "*Cordtex.*"—Each charge can be primed with a short length of "Cordtex"; they are connected to a main line of "Cordtex" and the blast is fired by means of a single detonator positioned on the end of the main line.

(3) *Propagation Method.*—In this method only the end charge in a row is primed with a detonator. When this hole is fired, the whole series of charges are detonated, due to the effect of the detonation wave produced by the end charge propagating through the waterlogged sand or silt to the second charge and so on along the line of charges. This method can only be applied in certain kinds of ground, but if a large-scale operation is to be carried out, it is worth while experimenting with this technique to see if propagation can be reliably obtained, as it obviously saves a great deal of time and materials.

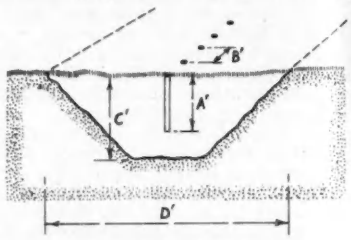

Fig. 5—"Single Line" Method

The following are typical distances over which propagation has been reliably obtained in the past :—

Charge per hole	Distance
½lb	1½ft
1 lb	2ft
2 lb	3ft
5 lb	4ft
10 lb	5ft

It is desirable now to consider in more detail the hole placement and charges adopted in this type of blasting. Where the "single-line" method, as illustrated in Fig. 5, is employed, Table I provides a guide as to the selection and placement of the charges.

A channel formed by the firing of a single line of 2 lb charges in the bed of an outfall channel can be seen in Fig. 4 and a photograph of a typical blast is shown in

Fig. 4—Trench Produced by "Single Line" Method

Fig. 6. This particular blast is about 200 yards long. As mentioned earlier, the flow of water through these "single-line" channels will tend to widen them. If the action of the water does not, however, produce the required result, then further charges may

Fig. 6—Side View of Typical Blast

be used, these being placed along the line of the silt forming the banks of the new channel. It is necessary in certain instances, however, for the full width of channel to be blasted in a single operation and in

TABLE I—*Selection and Placement of Charges*

Charge per hole (lb)	Depth of hole (A ft)	Distance between holes (B ft)	Probable depth of channel (C ft)	Probable top width of channel (D ft)
½	1½	1½	2½	5
1	2	2	3	7
2	3	3	4	9
5	5	4	6	12
10	8	5	10	16

these circumstances the "cross-section" method is recommended. This consists of a single line of holes down the centre line of the channel with perpendicular cross rows located at every other hole. This is shown pictorially in Fig. 8 and the following table may serve as a guide to hole placement and charges in the use of this method.

TABLE II—*Cross-Section Method of the Hole Placement*

Charge per hole (lb)	½	1	2	5	10
Hole spacing (*E*ft)	1½	1½	2½	4	5
Distance between rows (*F*ft)	2½	3	4½	6	8
Depth of hole (*G*ft)	1½	2	3	5	8
Depth of channel (*H*ft)	2½	3	4	6	10
No. of holes per cross row	Width of channel (*I* ft)				
3	8	10	14	20	26
5	11	13	19	28	36
7	13	16	24	36	46
9	16	19	29	44	56
11	18	22	34	52	66

Blasting of New Channels Through Sand-banks

So far consideration has only been given to the removal of sand and silt from existing water courses, but explosives have also been used to establish new channels through virgin sand-banks. The methods employed are basically the same as those described in the previous section and the hole placement and charges required are of the same order. It is perhaps best at this stage to consider a specific operation, namely, the reconstruction of a shipping channel in North Wales.[1] This scheme is represented pictorially in Fig. 7, and involved the cutting of three lengths of new channel through sand-banks.

The length *A* presented the major difficulties, as the sand-banks were up to 10ft high in this section. In forming the initial ditch along the centre line of the new channel the "single-line" method was employed. There were two alternatives available, either the full depth of channel could be obtained in one operation or two or three separate shallow lifts could be taken. The latter method was adopted, as the former would have involved punching holes up to 8ft in depth, which would have been very difficultin this compacted sand. The result of firing the first lift employing a single line of 2 lb charges can be seen in Fig. 9. Prior to the firing of the final lift of holes, a dam (Fig. 10) was constructed at *E*, Fig. 7, 1200 sand bags being used and these being reinforced by driving steel stakes down through the sand bags into the bed of the existing channel.

When the last blast was fired the sluice gates were opened and the dam forced the sluice water through the new ditch. The ditch at this stage was about 12ft wide, but during the next two days the sluice water alone widened the new channel to an average width of 24ft. Widening operations using explosives then commenced. Fig. 11 shows a close-up view of the new channel and men can be seen laying widening charges. Eventually the combined action of blasting and the sluice water had widened the new channel to the required dimension of 50ft.

Blasting Trenches Across Rivers

Reference has already been made to the blasting of pipe-line trenches in solid rock, but often similar trenches have to be blasted in silt or sand. For success it is important that any such operation should be planned down to the last detail, so that the operation can be completed in the minimum time. The complete length of trench should preferably be blasted in a single operation, the already assembled pipe-line being placed in position as soon as possible afterwards. In these operations the flow of water is across the excavation and thus silt is quickly washed back into the trench. Hence the need for speed will be readily appreciated.

One typical example of this work was carried out recently on the River Neath.[2] This scheme necessitated the blasting of a 7ft deep trench across the river bed to accommodate an 18in gas main. To make sure of obtaining the required depth a double row of holes were punched into the river bed, all these holes being at least 7ft deep, the two rows being 2ft apart, and the holes being spaced out in each row at 4ft 6in centres. The length of trench to be blasted was about 400ft and the blast, when fired, comprised a total charge of 1000 lb of explosive.

Meanwhile the pipe-line had been assembled and was floated upstream on a later high tide, and when in position over the trench was filled with filtered water from a nearby canal and so sunk into its required position.

An alternative method was adopted in blasting a trench to carry cables across the River Wyre. In this case "plaster" charges were used to blast a trench 3ft deep in the mud of the river bed. Employing this

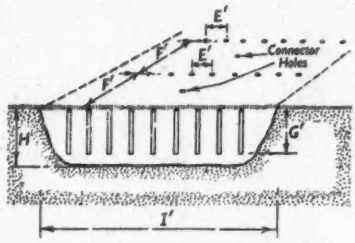

Fig. 8—"Cross Section" Method

method no bore-holes are required, a continuous explosive charge being placed on the surface of the mud. It is desirable to run a line of detonating fuse along the length of the charge to ensure adequate propagation.

To produce this 3ft deep trench an explosive density of the order of 1 lb per foot run was employed. Where deeper trenches are required obviously higher explosive densities will have to be employed. They can be tabulated as follows :—

Depth of trench required	Explosive density	Recommended cartridge diameter
2ft–3ft	1 lb/ft	1 ¼in
3ft–4ft	2 lb/ft	2in
4ft–5ft	5 lb/ft	3½in
Above 5ft	10 lb/ft	5in

Where 2in diameter cartridges are required it is possible to use "Geophex." As previously explained, "Geophex" cartridges can be readily coupled together into a continuous rigid column by means of special "Seislok" couplers. These long columns are eminently suitable for use as "plaster charges."

This "plaster charge" method is obviously heavier on explosives than the more orthodox "bore-hole" method, but at the same time it eliminates the laborious and costly work involved in punching the holes required with the latter. However, the "plaster

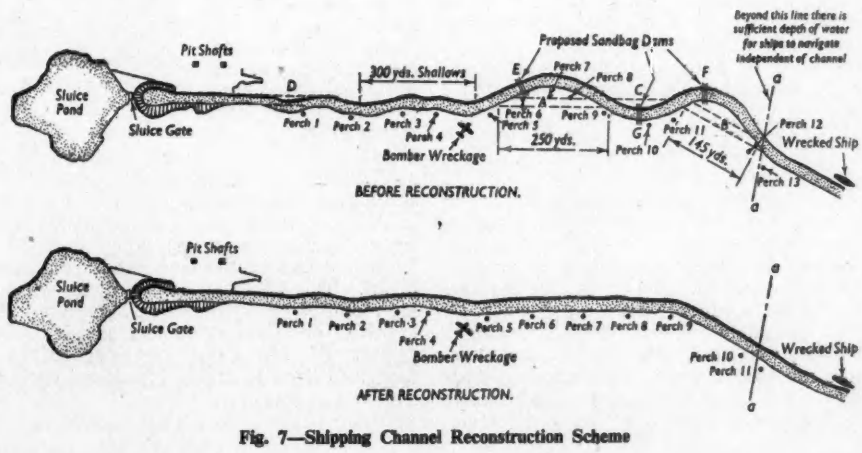

Fig. 7—Shipping Channel Reconstruction Scheme

charge" method can only be used in open country, as the air blast produced is severe.

Ground Vibrations and Waterborne Shock

Water and water-bearing deposits such as sand and silt are excellent transmitters of shock waves and many underwater blasting operations are associated with vibration difficulties. There are two factors to contend with, namely, ground vibration and waterborne shock. With charges confined in bore-holes the ground vibration will be the main factor to consider, the waterborne shock being relatively small, but with plaster charges the latter phenomenon will predominate.

When a charge of explosive is fired in the ground in a bore-hole, most of the energy goes in useful work, but some is transmitted through the ground in elastic waves. Examination of a large number of cases and actual measurement of ground movement from blasts led to the conclusion that a relationship exists between the amount of ground vibration, the distance from the shot and the weight of explosive fired. A specially designed vibrograph can be used to obtain suitable records. From these records it is possible to obtain the maximum amplitude and also the frequency of the vibration. From extensive work recently carried out, it is possible to estimate the amplitude various types of structure can withstand without suffering any damage.

By taking a vibrograph record it is possible to determine the amplitude associated with the firing of a given weight of explosive at a given distance. It is then possible to calculate the weight of explosive which can be safely used at various distances. These weights should then be regarded as the instantaneous charge limits for the site.

As far as ground vibration is concerned the following table can be used as a very general guide as to how much explosive can be fired at various distances from a structure :

Distance from structure	Weight of explosive to be fired at any instant
25ft	15 lb
50ft	55 lb
100ft	225 lb
200ft	900 lb

It should be stressed that these figures apply specifically to explosive charges properly confined in bore-holes, and does not account for any waterborne shock, nor is it intended to be anything more than a rough guide. It will be readily understood that conditions are very variable in this work and it is therefore impossible to lay down any hard-and-fast rules. For example, a mass concrete wall will obviously withstand any ground vibration to a greater extent than, say, a wooden pile structure.

Short delay blasting[3] can be applied to reduce this ground vibration. It is possible to divide up a blast of several holes by interposing a very short time-interval of the order of a few milliseconds between shots. For underwater work this delay can be most readily obtained by the use of short delay detonators or detonating relays.[4] By applying this technique the benefits of simultaneous firing of a number of shots are retained, while at the same time the amount of ground vibration is reduced. To take an example, suppose the instantaneous charge limit for a given site is 60 lb, the use of short delays would enable 40 lb to be fired on each delay, which, using No. 0–15 delay detonators, would give a total charge in any one blast of 640 lb. In other words, it is possible to fire two-thirds of the instantaneous charge limit on each delay without increasing the ground vibration. It should be stressed, however, that any advantage normally gained from the use of these short delay techniques is obviously eliminated if sympathetic detonation of adjacent charges is obtained. Particular attention should be paid to this aspect, where heavy charges are being used in underwater rock excavation.

Fig. 9—Length of Initial Ditch Immediately After Blast

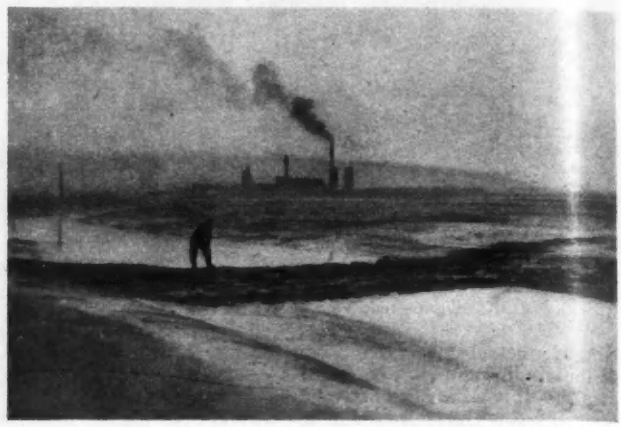

Fig. 10—Dam Across Existing Channel

Drill Boats and Mountings

Drill boats vary enormously in size and mountings, varying from an improvised raft, moored by chains in its required position, to a large drill boat mounting a few well drills and fitted with spuds to raise the boat out of the water to a height which insures quiet and secure operation. One drill boat in use in America which would come under the latter classification is 115ft long, 40ft wide and has a hull depth of 6½ft and a draught of 2ft. This boat carries two drills, which are mounted on rails running along the full length of one side of the boat, an air compressor of 620 cubic feet per minute capacity driven by a 165 h.p. diesel engine and also a fully equipped drill sharpening shop. Provision is made for moving the boat and it is fitted with four spuds. A craft recently used in this country on "trenching" work across the bed of a river carried a single well drill at the rear fitted with its own power unit. The drill boat was towed on to the centre line of the proposed trench and then made fast by four cables, one from each corner of the boat, to the shore. Four winches were situated on the boat, one in each corner, and by taking up and letting off with two of the winches at the same time the boat was moved backwards and forwards across the river by the pull in the ropes. When drilling was about to commence the drill boat could be more or less held stationary by tightening up on all the four ropes simultaneously. As one would expect, various kinds of amphibious craft are now being used in this work. Recently one such craft was used in the blasting of a compact clay layer in a river bed. A 3in portable pump mounted on the tail gate of the craft was used to jet holes into the clay layer.

Fig. 11—Close-up View of New Channel

We would like to thank the Nobel Division of Imperial Chemical Industries, Ltd., for permission to publish this article and our colleagues of Technical Service Department for their assistance and co-operation in compiling it.

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Structural Applications of Stainless Steel

By A. G. DEAN*

No. I

Serious consideration of stainless steel as a structural material started in the United States about 1930, first in airframes and later in railway coaches, followed by other applications. Many new problems of fabrication and design arose and were overcome. A variety of technical and semi-technical papers were written during this period. Now that some twenty years' operating experience has been accumulated structural applications are here reviewed, with particular reference to railway coach structures.

STAINLESS steel has become a generally accepted material for a variety of structures. It is useful principally where the finished article involves such a magnitude of labour that the investment should be protected by an imperishable structure. Certain devices such as jet engines would be so short-lived as to be impractical without the use of a truly corrosion-resistant material. This same rule applies, though less obviously, to railway coaches, highway freight trailers and various other products.

Physical Properties

There is a wide variety of stainless steel alloys available. They fall, generally, into two categories, namely, the ferritic, which are normally the straight chromium alloy with some 12 to 18 per cent chromium, and the austenitic, principally of the 18 chromium, 8 nickel nominal composition. The austenitic stainless steel is more useful for a variety of reasons. The principal ones, from a structural point of view, are that its tensile strength may be increased to a high value by cold rolling, which is a more useful and controllable process than heat treatment for thin materials. Secondly, its welding quality is excellent, which is particularly significant in the high strength, cold rolled, condition because the material does not harden due to the heat treating effect of welding. The class of stainless steel then which has proved more useful for structure applications is the 18–8 chrome nickel nominal composition,† cold rolled to various degrees, providing a physical property range from 80,000 to 150,000 lb per square inch minimum tensile strength, with a corresponding yield strength between 32,000 lb and 110,000 lb per square inch minimum.

The elongation will be, respectively, 55 per cent in 2in for the soft material and 18 per cent minimum for the high tensile. It has been found practical to rely more on bend tests than elongation, as a measure of ductility. The bend test assures freedom from cracks during fabrication and as compression strength is generally more critical, the bending ability of the steel becomes important. This is because a properly proportioned compression member will usually fail by local buckling, resulting in sharp bends in the material. It is important that the steel shall not crack when this bending occurs. There is a variety of steels which could produce similar physical properties. Little advantage could be taken of these properties unless the corrosion resistance is such that the resulting thin sections will not rust away within too short a time. This class of stainless steel has demonstrated its ability to withstand commercial atmospheres for an indefinite period. Experience to date shows twenty years' life with no deterioration of strength. This has meant that there is no limitation in the use of a thickness which is just suitable for the loads applied. Material as thin as 0·004in has been successfully used and thicknesses up to ¼in have been made in the high tensile temper. Practically, it is desirable to reduce the tensile strength above ¼in due to the difficulty of maintaining adequate elongation when cold rolling relatively thick metal.

HT temper in the Table corresponds to ½H in A.I.S.I. and other standard specifications: ¾H and H tempers at 175,000 lb and 185,000 lb per square inch minimum tensile strengths are also available. Reduced ductility and greater fabrication difficulties make these tempers unsuitable for railway structures, although they have been useful in airframes.

The properties discussed above have led to the successful use of this material in railway passenger coaches, highway truck bodies and trailers, ship superstructures, masts and uptakes, building trim and curtain walls, aircraft parts or complete structures, chemical tanks and similar equipment and jet engine construction. The cost of the material is high but for the applications listed above and others which may be similar, the greatly extended life and low maintenance cost of the structure will more than pay the difference in cost of the material.

Design

The greatest tonnages of stainless steel used structurally in the past twenty years have probably been in railway passenger coaches, where approximately 1950 American and 400 European coaches have been built, or are on order, and in highway trailers, of which about 23,000 have been built. In order to review more specifically the applications of stainless steel to structures, we will consider in some detail the application to railway passenger coaches. An example made by the author's firm is illustrated in Fig. 1. This is a special luxury coach termed the "Vista Dome."

The use of a railway coach body as an example for stainless steel structures is particularly suitable, as a considerable variety of structural requirements are involved. Appearance is important and should be associated with a minimum of non-structural decoration. Minimum weight is necessary, both for economical performance and low material cost. Some ingenuity is

TABLE I—*Standard Tempers—Strip Type* 301—*LT Sheets, Coiled or Flat Type* 302

Temper	Finish	Yield strength minimum	Tensile strength minimum	Per cent elong. desired minimum	135 deg. bend radius	Rock B maximum
LT	2 D	32,000	80,000	55	1 T	84
	2 B	32,000	80,000	45	1 T	95
ST	2 B	60,000	110,000	35	1 T*	—
MT	2 B	75,000	125,000	25	1½T*	—
To and including 0·125in thick HT	2 B	110,000	150,000	18	2 T	—
Over 0·125in thick HT	2 B	100,000	135,000	18	2 T	—

* Special conditions require 180 deg. bend ½ T radius where T is the metal thickness.
Carbon limited to 0·15 per cent up to 0·050in thickness and 0·12 per cent above this thickness.

Fig. 1—"Vista Dome" Railway Coach

* Assistant chief engineer, The Budd Company, Philadelphia, U.S.A.

† Defence restrictions in the U.S.A., drastically curtailing the use of nickel for civilian production, have accelerated research in the use of manganese in the place of nickel. Broadly speaking, twice as much manganese is required. An alloy consisting of nominally 16 per cent chromium, 17 per cent manganese and 1 per cent nickel is now being used for passenger-coach work. It is more difficult to produce in the steel mills but its physical properties are equal to and in some respects better than 18–8 types.

Fig. 2—Interior Structure of Stainless Steel Coach

required to proportion certain parts of the structure to maintain this pleasing appearance without the addition of non-structural sheathing. In the latest stainless steel cars, corrugations are used on the roof to maintain straightness in spite of the very thin material used, and to provide the necessary structural strength. Various longitudinal members in the side frame are contoured and polished to suit the architect as well as the stress analyst. The pier panels between the windows are kept flat by welding corrugations to the interior surface and the girder sheets below the windows are corrugated (Fig. 2). This wide pitch corrugation is shaped so that decorative trim strips may be snapped into place to cover the structural welding and the wide valley where buckling under load may be anticipated (Fig. 3).

The structure of a coach body is subject to two general categories of loading. In the first place it must sustain the weight of the structure, its equipment and live load for the expected life of the coach with various vertical and lateral accelerations or vibrations. In addition the longitudinal loads from the locomotive tractive effort and inequality of braking effort must be resisted for a suitable number of cycles. There are then occasional heavy longitudinal loads encountered in coupling the train at excessive speed and occasional rough operation of the braking system in emergency brake application.

The above loading conditions and expected number of cycles of application in, say, forty years, can be predicted reasonably well and, in some cases, measured in existing equipment. There are other important conditions which must be met whose magnitude cannot be predicted. This refers to performance in case of wreck. Some idea of the magnitude of these loads has been developed over a period of years by examining the damage resulting from various types of accidents and calculating the strength of certain members which have either failed or have successfully withstood such loading. This loading is principally longitudinal at either the centre line of the coupler, at about floor level, or up to some 18in above the floor level. Loads of a lower magnitude may be involved on the corners of the underframe and against the side of the car at various heights. In some cases the compression resistance and penetration resistance of the roof have assumed considerable importance.

We find then that some of the forces which the coach structure must resist are accurately predictable, others may be approximated and still others are only known to exist and good judgment must be exercised to provide a maximum practical resistance to them. By this time there has been enough history developed to begin to understand what magnitude of strength is effective to minimise the effects of crash conditions.

The Association of American Railroads has developed a specification for main line passenger equipment which covers most of these loadings. This specification is based on mild carbon steel having a yield strength of 32,000 lb per square inch. Where other materials are used, stresses may be increased in proportion to the increase in yield strength of the material to be used. This specification, in so far as it affects the strength of the structure, covers the following principal features :—

(1) The coach body is to carry its vertical loading at certain permissible stresses.

(2) The coach structure is to resist a minimum static end load of 800,000 lb applied at the rear draft stops in line with the centre line of coupler. This load to be resisted without any permanent deformation.

(3) The centre sill construction is to withstand a 400,000 lb load applied midway between the centre line of coupler and the centre line of buffer at the specified allowable stresses, giving a normal factor of safety of two.

(4) The coach body must resist a minimum longitudinal load of 500,000 lb applied at the centre line of buffer beam, which is taken to be 12in above the centre line of draft. This load to be resisted with no permanent deformation.

(5) The buffer beam is to resist a vertical load of 100,000 lb up or down, without permanent set.

(6) An anti-climbing provision is to be incorporated strong enough to resist the above 100,000 lb load taken at the yield strength of the material. Tightlock couplers are considered as meeting this requirement.

(7) The side frame posts are specified to have certain minimum section modulus values about both the longitudinal and transverse axes.

(8) A certain minimum thickness of side sheathing is required.

(9) Vertical beams in the end construction of the coach are specified to have minimum section modulus values. These are to minimise the effect of telescoping. These vertical beams are required also to have a minimum shear strength of 300,000 lb at the top of the underframe.

(10) The roof carlines are required to exceed a certain minimum value of section modulus and the roof sheathing is required to have a certain minimum thickness.

(11) A tabulation is also provided for allowable stresses, column effects and compression buckling. These values provide for a factor of safety of approximately two except for those parts of the specification limited by yield strength or permanent set under load.

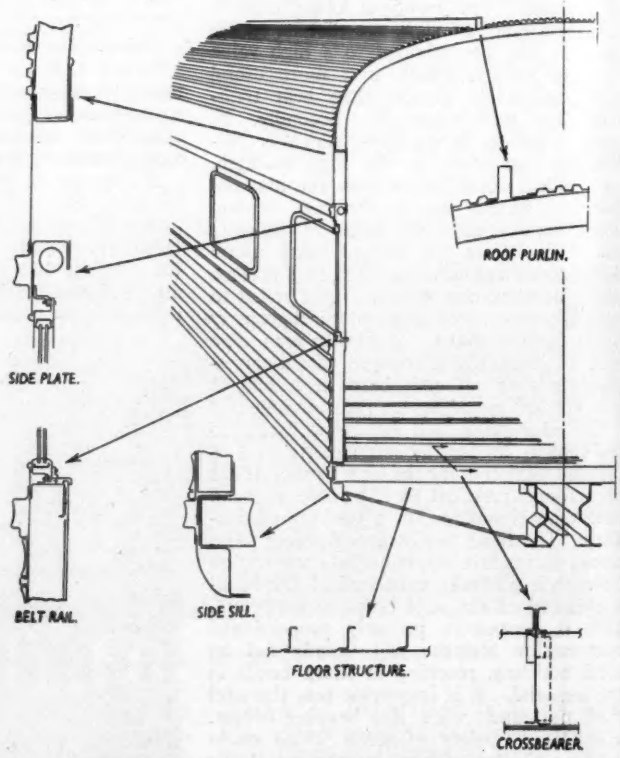


Fig. 3—Structural Details of Stainless Steel Coach

The above specifications are a combination of empirical values and values which can be predicted specifically.

Coaches built to these specifications have been quite successful in American operations at high speeds (say 80 to 100 m.p.h.) with trains weighing some 3,000,000 lb, including

the locomotives. It is felt that buffing strength, 50 per cent greater than this minimum, and this available for the entire length of the coach, together with more specific attention to the longitudinal rails in the sides and roof of the coach is usually worth the slight increase in cost and weight where the coaches involved are likely to be used in such heavy trains.

The modern structure to withstand the above loadings normally consists of a longitudinally strong underframe supported by side frames and roof structure with bulkhead members at the ends to maintain

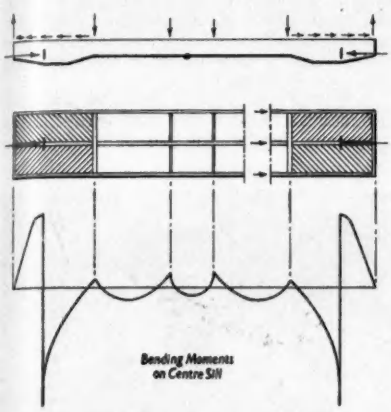


Fig. 4—Principal Forces on Underframe

torsional stiffness. The underframe at present used with stainless steel construction consists of a strong centre sill and a strong side sill at each side of the floor structure. It is possible to distribute sufficient material to resist the specified longitudinal loads in a variety of ways. The present stainless steel coaches are designed on the basis that the single centre member resisting most of the buffing load is more efficient than a plurality of smaller members. Side sills are useful to resist lateral accidental loads and may also carry some of the longitudinal load. To assure proper interaction between these two systems, a shear panel is provided in the floor supporting structure of the coach. This shear panel is stiffened with transverse members to support the side sill under transverse loading. Major cross members are provided at the bolster beam where the vertical load is transferred to the truck and at two points between bolsters. The principal function of these two intermediate cross members is to support the centre sill vertically so that it will function as a short rather than long column (Fig. 4). They also support the weight of the underfloor equipment. In fact, the centre sill is particularly useful in providing a solid attachment under the floor of the coach for the variety of equipment which a modern coach must carry.‡ Because of the heavy longitudinal loads at the bottom of the coach structure, the underframe is the heaviest unit of the coach.

The side frames serve as a shear resisting member between the underframe structure and the roof structure permitting the entire coach body to function as a beam to support the load between the trucks. These were originally designed as trusses covered with a sheathing of minimum weight. As construction details were developed with proper architectural considerations, it has become possible to build a structure whose surface can be largely exposed to view while maintaining the perfection of appearance desired. The side structure has, therefore, become the more conventional shear panel construction with a minimum of non-structural sheathing. The roof, together with an important longitudinal member above the windows on each side, forms the top chord of the coach body beam. The roof sheets are corrugated to maintain smoothness under the attendant compressive stresses. The shape is maintained by a number of transverse carlines spaced to provide proper column characteristics for the corrugations. The design of the side frame is complicated by openings for windows and doors. The location and width of doors may require additional reinforcement to transmit the shear across the opening and this reinforcement is principally in the roof, which provides the maximum vertical space available to resist these forces. Generally a reinforcing frame is provided around door openings to relieve stress concentrations. The structure is fabricated by the use of resistance welding or arc welding for maximum efficiency of the fastenings.

‡ Now usually includes a complete air-conditioning plant.

The end frames are shear bulkheads, including the vertical beams or anti-telescoping posts at either side of the end door opening.

Before a material can be used for structures, a reliable and economical method for joining members must be determined. Early efforts with gas and arc welding of stainless steel were unsuccessful and are still useful only in limited, though very valuable conditions. Riveting is possible but generally inefficient, difficult and costly. Stainless steel has all the characteristics desirable for spot welding but, prior to 1930, spot welding was not considered seriously for important structures and precisely controlled equipment was not available. The Budd Company (formerly the Edward G. Budd Manufacturing Company), which was the first to become interested in stainless steel structurally, developed a system for accurately controlled spot welds called the " Shotweld " system (Fig. 5). Under this system reliable and economical welds could be produced by following only a few simple rules. Reliability is controlled by a precisely accurate electronic (originally mechanical) primary current timer, simply adjusted current magnitude maintained constant by mechanically controlled electrode pressure, constant resistance by the nature of the steel, which has a uniformly clean surface, and a recorder sensitive to current and time, which advises the operator of any variation of cleanliness, impedance or mechanical variation affecting the strength of the weld produced. To maintain the inherent corrosion resistance of the stainless steel, the welding time is kept very short, one to twelve cycles of 60 cycle current.

The principal difficulties involved in designing such a structure are buckling of thin surfaces and stress concentrations of a magnitude permitting failure at low average stresses of the coach body. Buckling, particularly in shear, is generally permissible under rarely occurring loads in locations not visible to the casual observer. Where buckling is undesirable, the difficulty is overcome by providing formations in the sheets as demonstrated in the roof corrugations and the side corrugations below the windows. Welded stiffeners are applied where architecturally it is desirable to provide a smooth surface. The elimination or reduction of stress concentration is accomplished only by constant attention to detail, the use of large radius fillets and the avoidance of abrupt changes in section in general. Spot welds are inherently a source of stress concentration. Extreme care in the design of joints is necessary where fatigue loadings are of appreciable magnitude.

(*To be continued*)

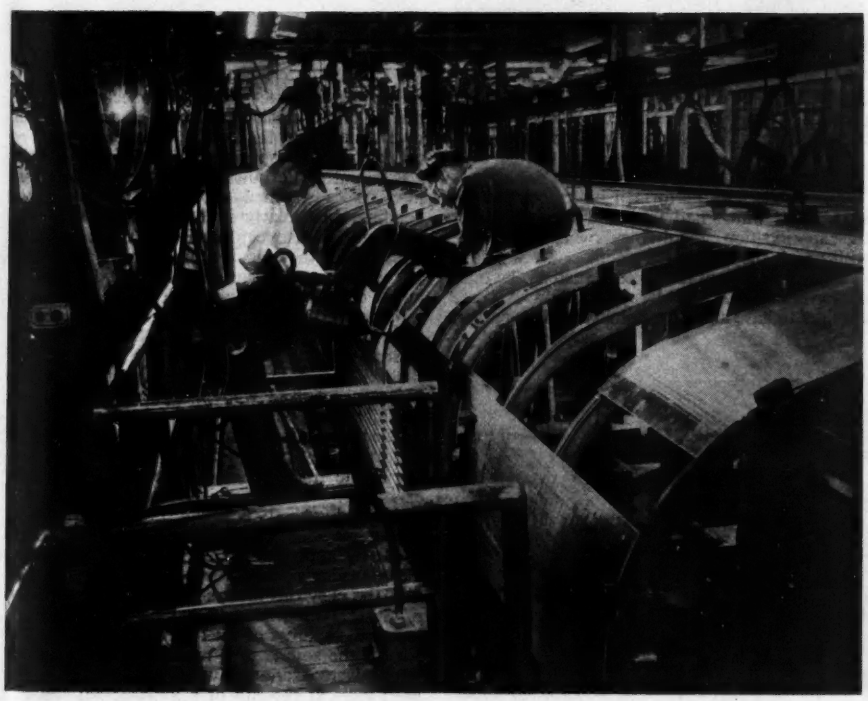


Fig. 5—Welding Stainless Steel Passenger Coach Roof

B.B.C. Coverage on the South Coast.—The B.B.C. announces that a three-acre site has been acquired at Pages Lane, Bexhill, approximately 1 mile west of the centre of the town, for the permanent low-power (2kW) transmitting station that is being provided to improve reception of the Home Service in the area. It is stated that construction will start immediately, and when completed the station will take over the service on 206m (1457 kc/s) at present given by the temporary transmitter of lower power near Hastings. The latter covers little more than the town itself, but it is expected that the permanent station with its higher power and better site will extend the area of satisfactory reception to include also St. Leonards, Bexhill and Eastbourne. The permanent station expected to be in service before the end of the year.

Ship Failure Research at the National Bureau of Standards

(By Our American Correspondent)

The National Bureau of Standards has been assisting a Board set up by the U.S. Navy to investigate the design and methods of construction of welded steel merchant ships. In particular the Bureau has undertaken the examination of plates removed from fractured ships. Tests have been completed on 126 plates taken from sixty-five such ships and some of the results are discussed here.

IN the course of the past nine years, losses due to the structural failure of American welded merchant ships have reached almost 50,000,000 dollars, and there have also been costly failures in other welded structures, such as bridges, storage tanks and pressure vessels. At least ten tankers and three " Liberty " cargo vessels have broken completely in two as a result of the propagation of fractures which originated at some point in the hull structure or its appendages. About twenty-five other American vessels have suffered complete fractures of the strength deck or the bottom plate. Although fractures have also occurred in riveted ships and structures, these fractures usually ended at the first joint and did not propagate into adjoining plates. A welded structure, however, is continuous, and a crack may therefore propagate across the welds from one plate to the next, resulting in a complete structural failure. Therefore, the problem of fracture origin and propagation has received more attention in the past few years, since welding has largely replaced riveting in the fabrication of ships and many other structures.

In April, 1943, the Secretary of the U.S. Navy established a Board to Investigate the Design and Methods of Construction of Welded Steel Merchant Vessels. That board and its successor, the Ship Structure Committee, conducted extensive technical and statistical studies of the casualties, and initiated research projects in several laboratories for the study of some of the factors involved. The Metallurgy Division of the National Bureau of Standards, which had already assisted in investigations of some of the earlier failures, was given the task of investigating the plates removed from the fractured ships, and the U.S. Coast Guard made arrangements for samples of fractured plates to be sent to the Bureau. Up to the present, the N.B.S. metallurgy laboratory has received and examined samples from nearly 100 ships in which fractures have occurred, and tests have been completed on 126 plates selected from sixty-five of these ships. When sufficient and suitable material was available, the laboratory investigation included examination of the fracture and of the welds involved, microscopic examination, chemical analyses of the plates, Charpy " V "-notched bar tests over a range of temperatures, and tensile tests. To co-ordinate the results of the laboratory investigations with service experience, information was obtained from the U.S. Coast Guard and other co-operating agencies regarding the circumstances of the casualties, the structural details of the ships involved, the position and extent of the fractures and other pertinent details.

It is now generally agreed that there are three basic factors involved in the prevention of failures of welded structures. First, the materials of construction should uniformly possess the properties anticipated by the designer, and these properties should not be affected adversely by the effects of fabricating operations or operating conditions. Secondly, the design should produce an economically sound structure capable of performing its required functions under all operating conditions. Thirdly, the welded fabrication should be performed in accordance with the requirements established by the designer, and must produce joints of the strength which he intended. At the Bureau of Standards, the work of the Metallurgy Division has been concerned primarily with the first of these factors, that of the Mechanics Division with the second.

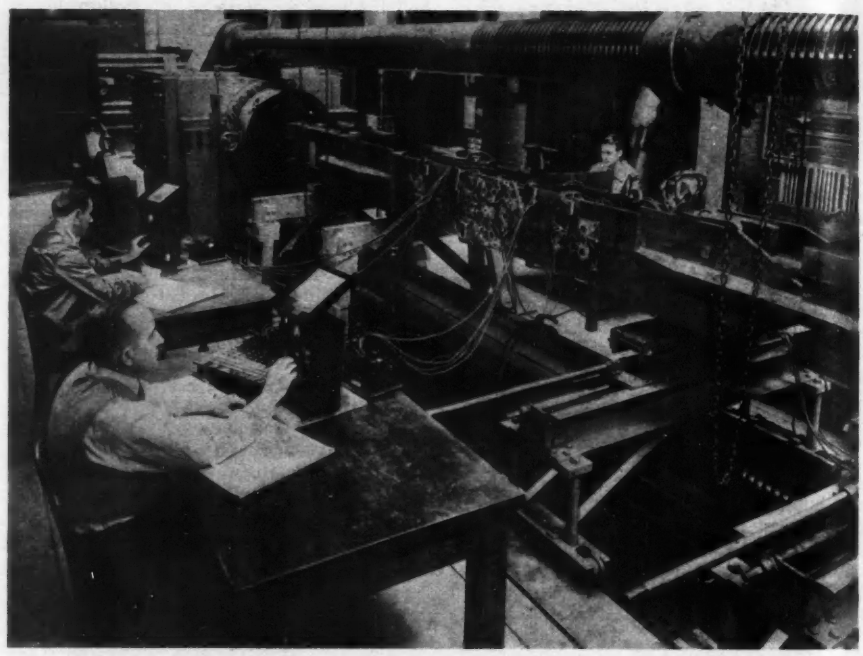


Fig. 2—Tensile Test of Interrupted Longitudinal Specimen

Materials

The tensile tests performed indicated that the ship plates which had fractured in service met the specification requirements in accordance with which they had been purchased. Standard American structural mild steels, such as the ones conforming to A.S.T.M. specification A7, are required to have an elongation in 8in of more than 20 per cent, and a reduction in cross-sectional area of about 50 per cent. These values indicate that the material is normally capable of considerable plastic deformation before it will fracture. The fractures in the ships, however, showed very little evidence of plastic deformation, or ductility. Nearly all of the fractures were of a brittle type, characterised by a break nearly perpendicular to the plate surfaces and a coarse granular or crystalline appearance. The reduction of thickness at the fracture edge was very small, usually less than 2 or 3 per cent, and the paint or scale on the plate surfaces was not cracked, even very near the fracture. This showed that the fractures had propagated with very little plastic deformation of the steel. Since energy is proportional to the integral of stress times deformation, it thus became evident that much less energy was absorbed in the propagation of these fractures than in normal ductile fractures of the same material.

The lack of ductility and the brittle nature of the fractures indicated that when the steel was incorporated in the structure of the ship, the mechanism of fracture, or the mechanical properties of the steel, were not the same as when determined by the usual tensile test using relatively small specimens. This phenomenon was found to be quite similar to that observed in tests of notched specimens in tension or bending, particularly at low temperatures. The similarity is also evident in the facts that the fractures in the ships occurred more frequently at the lower temperatures, and that the starting points of the fractures could be traced, invariably, to geometrical or metallurgical notches resulting from structural design details, fabrication processes, or welding defects. It is now well known that this phenomenon, called notch brittleness, is not peculiar to ship plate alone, and is not confined to metals.

The herring-bone markings or chevrons in the fracture were found to be characteristic of the brittle fractures in most of the ship plates examined. Earlier tests on brittle failures conducted at the N.B.S. had shown that a brittle failure may be produced in a normally ductile metal by applying a tensile stress to a notched plate specimen, and also established the fact that the chevrons always point back toward the origin of the fracture, making it possible to locate the sources of the fractures. As shown in Fig. 1, the source of a number of the fractures which were examined was found to be in the shell plate at the end of a longitudinal stiffener (*A* and *B*), within a few inches of a transverse bulkhead. Here the longitudinal, which is

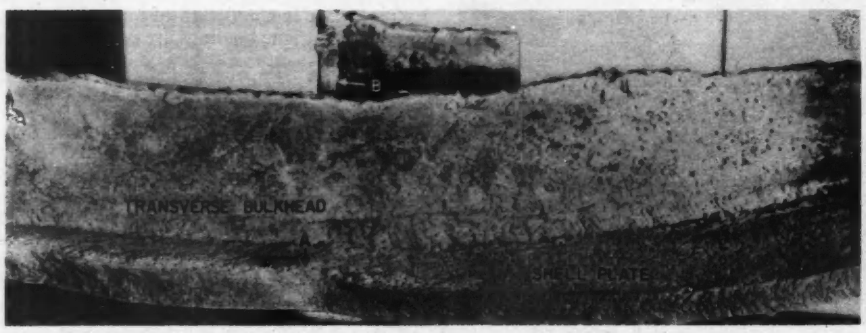


Fig. 1—Edge of Fracture in Shell Plating of a Welded Tanker

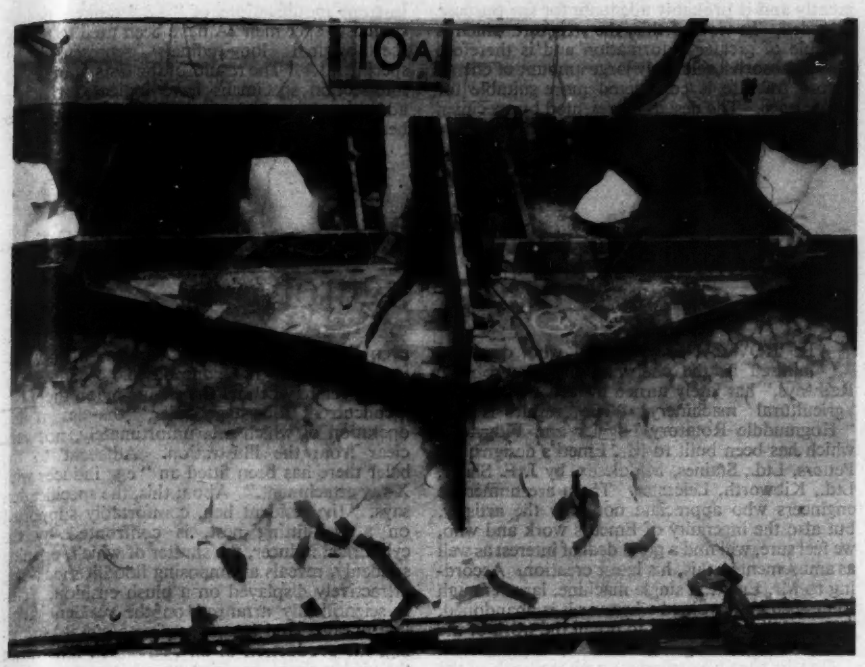


Fig. 3—Failure of Interrupted Longitudinal Specimen at Low Temperature

welded to the shell plating, is interrupted for a space of about 6in to allow for the insertion of the transverse bulkhead, to which it is connected at a point several inches from the shell plating, by gusset plates on the flanges of the longitudinal. This condition, which constituted a structural notch at the abrupt end of the longitudinal stiffener, was responsible for a number of failures in tankers and, hence, the design detail is one of those being investigated at present.

The importance of the notch brittleness of the steel as a factor in the failures was recognised early in the investigation and impact tests, using "V"-notch Charpy specimens, were included in the examinations of the fractured plates in order to determine this factor. In such impact tests of notched specimens, most steels are "notch-tough" at higher temperatures, but, as the temperature is lowered, they become, suddenly or gradually, more brittle, and the energy required to produce fracture is reduced to a small fraction of that which can be absorbed at higher temperatures. The range of temperatures within which these changes take place, for a given steel, is now called the transition range of that steel. It has been found convenient to refer to a specific point in this range as the transition temperature, and to define it as the temperature at which the energy absorbed is, say, 50 per cent of the maximum, or as the temperature at which the energy absorption is at a definite level of, say, 15ft-lb for a "V"-notch Charpy specimen. The transition temperature thus becomes one measure of the notch brittleness of the steel.

Comparison of Average Transition Temperatures of Welded Ship Plates

Category of plate	Number of plates	Average transition temperature	Standard deviation
		Deg. Fah.	Deg. Fah.
"Fracture source" ...	30	102·5	25·0
"Fractured through"...	45	65·7	17·5
"Fracture end"	38	56·3	20·1

After impact tests had been completed on only a few plates, it was observed that the plates in which the ship fractures originated showed higher transition temperatures than those plates which did not contain a fracture source. Therefore, the fractured plates for which definite information was available were classified into three categories: those which contained a fracture source, those which were fractured through, and those which contained the end of a fracture. The plates were also classified in groups on the basis of plate thickness, to permit the comparison of data for similar material. The accompanying table contains the essential data taken from curves showing the frequency distributions of 15ft-lb transition temperatures of plates falling, respectively, into the "fracture source," "fractured through" and "fracture end" categories. The "fracture source" plates were found to have a higher average transition temperature, while the relative proportion of "fracture source" to "fractured through" plates in each interval increased with increasing transition temperature. The latter indicates that the probability of a fracture starting in a plate, under the conditions existing in a structure such as a ship, increases markedly with increasing notch sensitivity of the plate, as determined by the 15ft-lb transition temperature of the "V"-notch Charpy specimens.

The frequency distribution curves obtained also showed that the plates with high transition temperatures, in which fractures are most likely to originate, represent the relatively few plates whose notch sensitivity falls in the tail of the probability curve for steels of the quality used when these ships were built. This is believed to suggest two possible remedies: (1) An improvement of the average quality of the steel with respect to notch sensitivity, and (2) a determination of the notch sensitivity of every heat of steel by inspection tests, and the rejection of all heats which fail to meet suitable prescribed standards. In order to provide information pertinent to steel qualities, the test results have been compared with the chemical composition of the steels and an extensive statistical analysis has been made to determine the effects of individual elements. This analysis has showed that the notch sensitivity is increased with increasing amounts of carbon and phosphorus, and decreased with finer grain size and with increasing amounts of silicon and manganese, within the range of the chemical compositions of the ship plate steels under review.

Structural Design

A welded tanker afloat at sea may be considered as a hollow beam of great depth upon which a system of complex and variable forces operate. Practical solutions of the problems of designing and constructing a steel ship result in various and numerous structural discontinuities, especially at the connections of intersecting members and plates. Such discontinuities often constitute a "mechanical notch" and nearly always have been found to produce some concentration of stress in the area of the discontinuity. Since the load-carrying capacity of the structure or ship as a whole, and its ability to absorb energy of deformation, may be seriously reduced by excessive stress concentration, the design details at discontinuities are especially important. The American "T2" all-welded tanker was designed and developed during the last war to take advantage of ship plate steel then available in large quantities and to minimise time-consuming fitting and joining processes. A large number of these ships were constructed and served their intended purpose. However, to ensure and prolong the life of these ships, modifications of certain structural details had been made with undetermined results. The main purpose of the investigation in the Mechanics Division of the N.B.S. was to evaluate the load carrying and energy absorption ability of certain original structural designs and a few practical modifications of these designs.

Observations on the ships and examinations of fracture sources indicated that fractures occurred in those parts of the ship sustaining large tensile loads. In view of this and the impracticability of simulating exact shipboard loading conditions, tensile tests of the design details in question were made in the laboratory. The specimens used were similar to practical ship members as far as material, plate thickness and welding procedures were concerned. Since a large number of the fractures occurred in cold water, most of the specimens were tested to failure at temperatures near 0 deg. Fah. Some longitudinal specimens were tested at various other temperatures to obtain an indication of the effect of temperature on the mode of fracture. Fig. 2 shows an interrupted longitudinal specimen being tested on a horizontal machine having a tensile testing capacity of 1,150,000 lb. Fig. 3 shows the fracture of a longitudinal specimen tested on the machine under low-temperature conditions.

A source of many of the serious ship failures

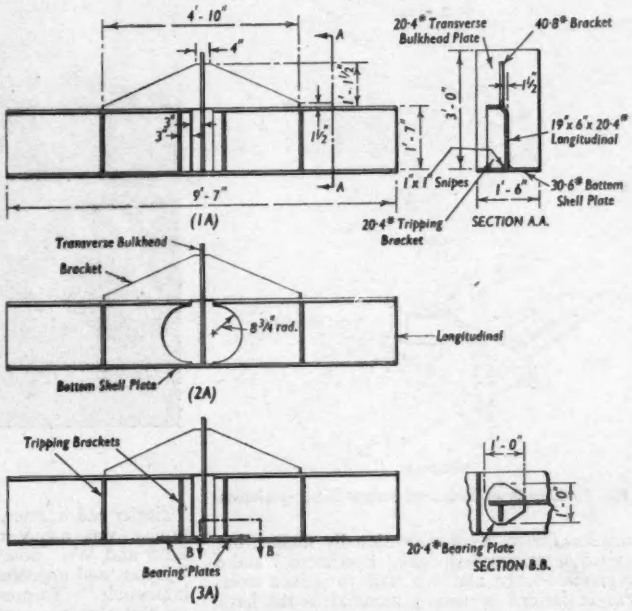


Fig. 4—Details of Interrupted Longitudinal Specimen

was at the intersection of a bottom longitudinal and a transverse bulkhead, a design detail which is repeated more than one hundred times in the structure of these tankers. Three general designs of this detail were investigated by the Bureau and are illustrated in Fig. 4. Specimen 1A represents the original design used in the "T2" tankers and is relatively rigid. Specimen 2A is a more flexible structure because of the removal of material by a semicircular cutout. Specimen 3A retains the rigidity of 1A, but reduces the stress concentration in the bottom plate by increasing the plate thickness at the point of highest stress. Some representative results of these tests are shown in the table below.

Results of Interrupted Longitudinal Specimen Tests

Specimen design	Test temperature	Maximum load	Energy to fracture
	Deg. Fah.	lb	ft-lb
1A	0	750,000	30,700
1A	−15	843,000	28,300
1A	40	1,083,000	102,900*
1A	20	1,015,000	62,700
1A	−5	905,000	36,300
1A	5	1,052,000	94,100
1A	0	960,000	64,300
1A	−5	912 000	36,000
2A	0	774,000	46,100
2A	0	993,000	121,600*
2A	0	918,000	141 000*
2A	−20	826,000	11,300
3A	0	843,000	49,700
3A	10	1,091,000	126,300
3A	−5	1,047,000	65,900*

* Broke outside of intersection.

Four bulkhead intersection specimens of three general designs were investigated; they are illustrated in Fig. 5. Specimens 5 and 6, the

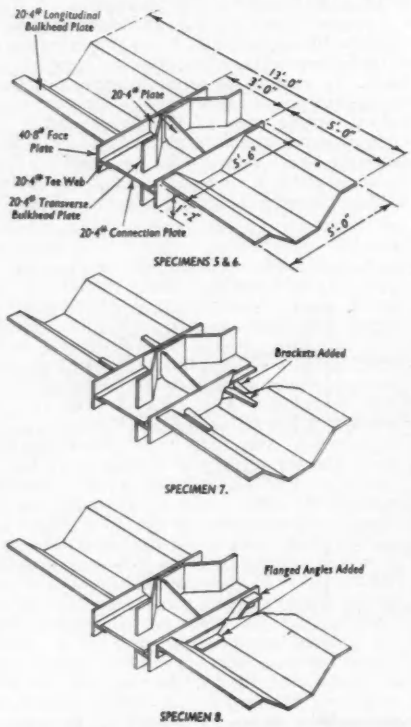


Fig. 5—Details of Bulkhead Intersection Specimens

original design, were dimensionally similar, but varied in welding technique. Specimens 7 and 8 represented two methods used to reduce stress concentrations by adding material to the basic design. The results of the tests on these bulkhead specimens are given in the following table.

Results of Bulkhead Intersection Specimen Tests

Specimen No.	Maximum load	Energy to fracture
	lb	ft-lb
5	860,000	11,400*
6	774,000	61,800†
7	944,000	45,200†
8	1,129,000	68,800

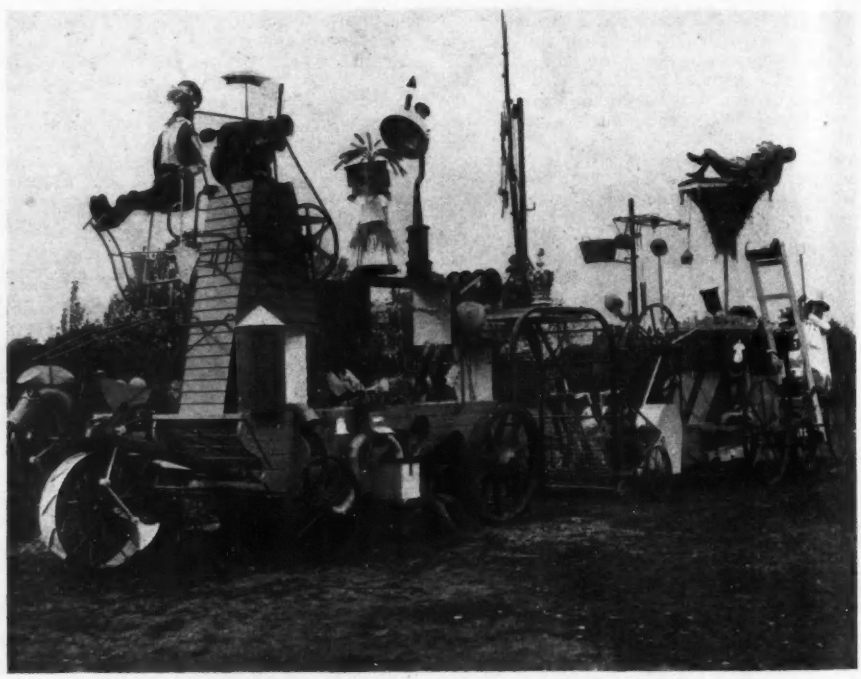
* Partial fracture.
† Fracture began in defective weld.

The results of the tests at the N.B.S. have indicated that the load-carrying ability of the interrupted longitudinal designs does not vary greatly and is probably adequate for the purpose intended. In view of this, the structure which is capable of greater deformation and is therefore able to absorb a relatively large amount of energy before fracture is considered more suitable for this service. The design represented by specimen 2A appears somewhat superior in this respect. In some modifications of "T2" tankers designs similar to specimen 2A have been used to replace the original longitudinals represented by specimen 1A. The results of the tests of bulkhead intersection specimens have indicated that the addition of material near regions of high stress is beneficial.

The Hogmuddle Rotatory Niggler and Fidgeter

MR. ROWLAND EMETT, who describes himself as the chairman of "Improbable Railways," has lately turned his artistic genius to agricultural machinery. The result is the "Hogmuddle Rotatory Niggler and Fidgeter," which has been built to Mr. Emett's designs, for Petters, Ltd., Staines, Middlesex, by J. E. Slater, Ltd., Kibworth, Leicester. There are numerous engineers who appreciate not only the artistry, but also the ingenuity of Emett's work and who, we feel sure, will find a great deal of interest as well as amusement in this, his latest creation. According to Mr. Emett, a single machine, large enough to be seen and avoided wherever it is abandoned, and complicated enough to do all the work of the farm, will fill a long-felt want!

On this page we reproduce a photograph of the



The Hogmuddle Rotatory Niggler and Fidgeter

"niggler and fidgeter," which, it should be mentioned, was highly commended at the recent Bath and West Southern Counties Show as a "joyous and improbable attempt to achieve the impossible." To provide a suitable description, we feel that we cannot do better than quote liberally from a copy of the "official specification" with which we have been supplied. As may be gathered from our illustration, the machine is of "noble proportions" with its weight distributed over several wheels of diverse patterns. Power for the whole outfit —and the moving parts do indeed work!— is provided by a Petter 10 b.h.p. air-cooled petrol engine. Emett decided that this engine should be installed at "the summit of the great engine pylon, which cleverly places it out of the reach of possible hostile hayforks and maintains it well above the average mean yearly level of evening mists." This, the specification adds, "entirely abolishes those tiresome coughing-fits to which even the healthiest engine is prone when working after the sun has gone down."

Immediately behind the engine pylon there is a "concurrent four-stage baler," the design and operation of which are, unfortunately, not very clear from the illustration. Adjacent to the baler there has been fitted an "egg inducer with X-ray attachment." About this, the specification says, "the resident hen, comfortably supported on a well-fitting nest, is confronted by the cylindrical inducer, the shutter of which, opening suddenly, reveals an imposing floodlit mock-egg, attractively displayed on a plush cushion. This is scientifically arranged on the resident hen's line of sight and suggests, after a suitable time-lag, the production of an egg, which falls down the visible chute, marking up a score report, and shows an X-ray section of the egg under review." The "rotary stook-drier and setter" and the "agro-mechanic's" seat, both of which are clearly shown in the illustration, complete the primary section of the niggler and fidgeter. The secondary section is joined to the primary section by the "Hogmuddle free-flow arch," the purpose of which is to "allow access for the local hunt, which might otherwise be disturbed by the length of the machine." Above this arch is the mounting for a "combined hedge-trimmer and gentlemen's hairdresser," the main components of which are three pairs of spring-operated scissors!

The principal part of the secondary section of the machine is the "wurzle-digger, scrubber and polisher, embracing the fully automatic Hogmuddle carrot-rejector." On this, we quote, in full, the specification as follows :—"The wurzles are dug, as the machine moves over the field, by the four-fork scrabbler, which removes them from the earth and impales them on the prongs of the

large Ferris wheel. As the wurzles rise they rotate, thus ridding themselves of stones, pests, &c. Just before top-dead-centre, each wurzle is individually scrubbed with a suitable earwig-defying detergent and afterwards dried and feather-dusted, providing wurzles fit in every way for the showcase or mantelpiece. With this machine, should a carrot inadvertently be dug, the Hogmuddle-rejector immediately comes into play. The carrot, all rotary movement stilled, is advanced slowly towards the rejector-trap, which leaps forward to receive it. The lid opens, and immediately snaps-to behind the engulfed carrot, thus preventing any escape. The trap, quietly settling back, passes the carrot to the vibratory carrot-fuddler, which, absolutely divorced from the main wurzle-hopper, renders the carrot entirely harmless, except for subsequent carrot-purée."

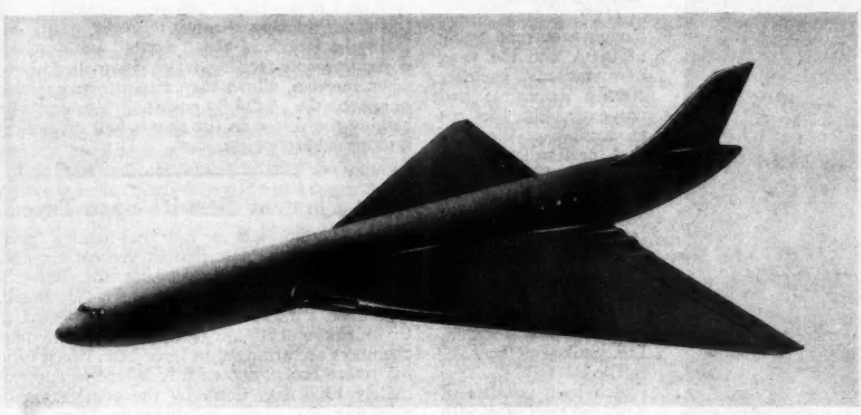
A word or two must also be said about the "control office" which Emett has thoughtfully devised for "taking care of most of the paper-work on the farm." He claims for it that "Government forms moving smartly on an endless belt are filled in, stamped and carefully disposed of quite painlessly as the machine is working, thus leaving the gentleman farmer entirely free to enjoy the revolving feather-bed from which he may survey in comfort the prospect before him and the feverish activity below." Incidentally, there may be noted, beneath the "feather-bed," a "rotary hay-stack fed by a reversible hay lift." This lift, Emett explains, "forms a useful method of supplying the gentleman farmer with refreshment, but on no account should a farmer's boy attempt the ascent with supplies when the belt is in reverse."

In presenting this "description" of the "Hogmuddle rotatory niggler and fidgeter," we should like to congratulate Rowland Emett, Petters, Ltd., and J. E. Slater, Ltd., on their combined efforts to provide something out of the ordinary.

The Avro "Atlantic" Delta Transport Project

THE firms now engaged on the super-priority production of four-engined jet bombers in this country have each prepared project designs of large transport aircraft largely based on the respective company's bomber configuration and performance. The "Atlantic" project illustrated below is that prepared by A. V. Roe and Co., Ltd., and, as can be seen, it has the delta configuration with which this company is particularly associated. Its resemblance to the "Vulcan" four-jet delta bomber which the company first flew last year will be recalled, although the "Atlantic" would be considerably larger.

It is a project designed basically for routes such as that from London to New York, without the need to refuel at intermediate points. The optimum economic size is consequently determined by this requirement and the "Atlantic" would have a basic seating accommodation on this route for ninety-four passengers. The designed speed and altitude are in the region of 600 m.p.h. and 40,000ft respectively, and the all-up weight of the order of 200,000 lb. According to fuel requirements the pay load would vary from 10 to 20 tons. The design envisaged for the "Atlantic" is described below.



The Proposed Avro "Atlantic"

Structure

The fuselage is a light alloy stressed skin structure which is built in four main units. They are the nose section containing the flight deck, the front centre section, the centre section, and the rear section. The centre section fuselage is built integrally with the torsion box structure of the centre section wing which embraces the centre and rear spars extending to the transport joint outboard of the undercarriage bay. The centre section of the front spar, which is jointed at the fuselage sides, is built integrally with the front centre section of the fuselage. All spar members pass through the fuselage below the level of the main floor. The fin is built as a separate unit. The wing outboard of the undercarriage bays is a light alloy structure of great rigidity in which new methods of construction are utilised. Structural provision is made for anti-icing.

The rudder, elevators and ailerons are aerodynamically balanced and sealed at their leading edges to the fixed structure. All the flying control surfaces are operated by duplicated irreversible electro-hydraulic power units. Artificial feel units are provided for all control surfaces. Each of the two main wheel units is fitted with a multi-wheeled bogie and single shock-absorbing strut. The nose wheel compartment is non-pressurised. The hydraulic braking system incorporates "Maxaret" automatic wheel braking units.

Engine Installation.—Four power units, in pairs, are completely buried within the wing at each root. The space at these positions in a delta wing enables various engines to be installed without structural alteration. Each engine is mounted in a fireproof compartment and is fully accessible from beneath the aircraft. All fuel is carried within the wing outboard of the engines and normally the fuel on one side of the aircraft is used by the engines on that side. The fuel is contained in a number of flexible tanks with the piping system arranged so that any engine may be supplied from any tank or combination of tanks. Fuelling points are located in each main wheel bay.

An extensive programme of tests under many and varied conditions of flight with the company's "Vulcan" four-jet bomber and its small scale prototypes has shown that the handling characteristics of the delta wing are quite orthodox and that no new problem is encountered over the entire speed range from take-off or landing to high subsonic speeds.

The cabin is pressurised to 9 lb per square inch, which ensures a cabin altitude of approximately 8000ft when the aircraft is flying at 45,000ft. Adequate heating, ventilation and air conditioning are also provided. Quietness in the cabin is an important consideration and from the accompanying illustration it can be seen that all normal passenger accommodation is ahead of the noise cone of the jet pipes.

Passenger Accommodation

Since the design of the fuselage permits almost any seating layout a wide selection of interior arrangements may be considered. The provision of bulkheads which may be repositioned or removed extends this choice of layout.

The layout of the basic version is arranged so that ninety-four passegers may be accommodated in three compartments. The forward cabin has seats for twenty-four, the centre cabin has seats for fifteen, and the rear cabin fifty-five. All seats are pitched at 42in, face rearwards and may be adjusted individually. Each row of seats, divided into groups of three and two with intervening gangway, is flanked by windows. When the bar is omitted 109 seats may be installed. In the rear compartment individual bunks, hinged from the cabin walls above the seats, provide alternative accommodation for eleven of the passengers.

In the tourist version each row has six seats with a central gangway and the totals in each compartment are twenty-nine, eighteen and sixty-six respectively from front to rear. This total of 113 is increased to 131 if the bar is omitted.

Freight and baggage compartments have a capacity of 1900 cubic feet. Floors throughout the aircraft are designed for distributed loads of 75 lb per square foot.

An Automatic Shell Mould Making Machine

DEMONSTRATIONS were recently given in London of the prototype model of a new design of automatic shell moulding machine designed by Mr. A. Wansburgh-Jones to the order of Clino Foundry Supplies, Ltd., Clyde Vale, Dartmouth Road, London, S.E.23. This machine, known as the "Autoclino," is adaptable for either long-run quantity production or short-run batch production. Once the times for the various operations have been determined, the machine can be set for a completely automatic production cycle which is non-repeating and is started by depression of a push button. A master time-switch controlling the operation of the machine gives a fixed duration for each operation according to the setting of four independent switches preset by hand to the required times. These independent switches take over from the master switch at appropriate times during the shell-making cycle and actuate solenoid-operated pilot air valves through which compressed air is admitted to pneumatic cylinders actuating machine movements.

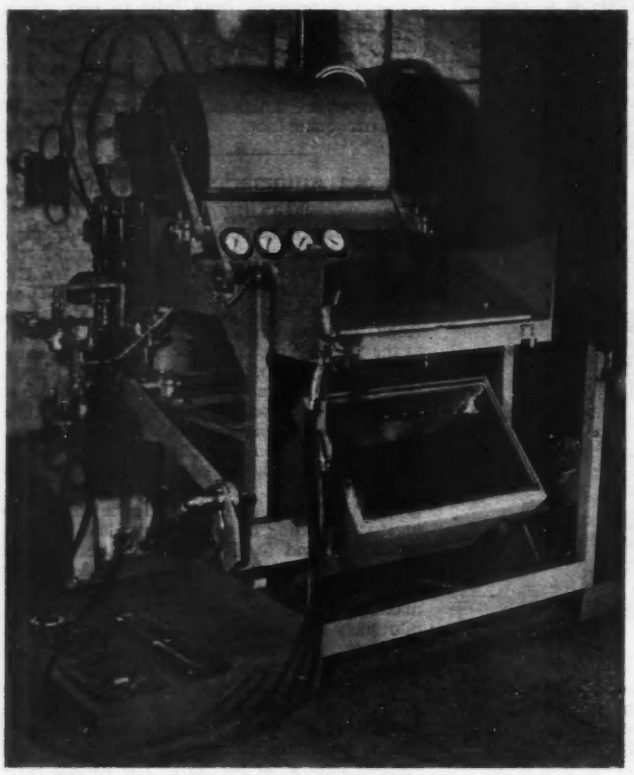
A photograph we reproduce overleaf shows the machine with its guards removed. It has a rigid frame of fabricated structural steel members and is complete with an air compressor and receiver built in at the rear. The pattern plate with an area of 16in by 28in is of sufficient size to take both the bottom and top moulds of a wide range of castings, or full-size half moulds if required. A frame on which the plate is mounted is supported on trunnion bearings, one of the trunnion pins being extended and keyed to a toothed quadrant. This quadrant is in mesh with a rack at the end of the piston of an air cylinder, and admission of air to the cylinder turns the pattern plate frame on its bearings through the quadrant.

A dump box set beneath the pattern plate frame is tilted forwards at an angle of 45 deg. in its rest position to facilitate inspection of its contents and the loading of fresh mixture. This box has brackets on each side, through which it is carried at the end of long levers extending

and fixed to a cross shaft in the machine frame. A third lever connected to the cross shaft is coupled to a pneumatic cylinder piston-rod and admission of compressed air to the cylinder raises or lowers the box relatively to the pattern plate. In the cycle of operations the dump box is raised to contact and lock on the pattern plate frame before it rotates for the investment of the mould. During this operation the box is steadied by short shafts at its ends, which slide into slotted bearings. A silicone rubber gasket is fitted round the top of the box where it makes contact with the pattern plate and, if required, the rim of the box can be cooled by circulating water.

Curing is effected by means of a series of infra-red elements arranged beneath a large hood, to be seen at the top rear of the machine. This hood is supported by two levers mounted on a cross shaft which is turned by means of an air cylinder through a gear quadrant and rack. As the shaft is turned the hood is swung forwards in an arc till it comes to rest above the pattern plate. At the end of the curing period the hood is swung back by the admission of air to the opposite side of its pneumatic cylinder. At the end of the cycle the investment box is raised against the lower part of the pattern table, where it contacts ejection pins which lift the mould off the pattern.

Two control panels are mounted at the rear of the machine—one for controlling the sequence of operations and the other for timing the cycle periods. A series of cams mounted on a motor-driven shaft actuate the switches of the solenoid-operated pilot valves controlling the main supply valves to the pneumatic cylinders. By means of a series of switches the valves can be operated independently when required, and this independent manual operation can be used to ascertain the correct time sequences for the automatic cycle. Four dials arranged on the timing control panel are for the pattern plate preheating, the investment period, the curing and the ejection periods. By setting the pointer on each dial by means of a control knob the required periods for each function can be quickly and easily set.



Shell Mould Making Machine

In the operating cycle of the machine the pattern plate is first preheated by swinging the hood into position for a predetermined period. When the hood has been swung back the pattern plate is reversed ready to meet the dump box containing the sand/resin mixture. The dump box then rises to meet the pattern plate and the box and plate turn over to enable the sand/resin mixture to invest the pattern. After a set period this movement is reversed to allow surplus mixture to fall back in the box, which is then lowered away from the plate. When the pattern and its investment have turned over to the original position the heater hood swings over for the final cure. At the end of a preset time the hood returns to its stand and the dump box is lifted up to the ejector plate, which engages with the ejector pins to raise the shell mould approximately 2in and hold it off the plate for removal by the operator. The dump box is then lowered again and the machine is ready to commence another cycle of operations upon the starting button being pressed. During operation of the machine a constant indication of the heat of the pattern plate, the air pressure, &c., is given to the operator by the dials on a panel facing the operator at the back of the pattern frame.

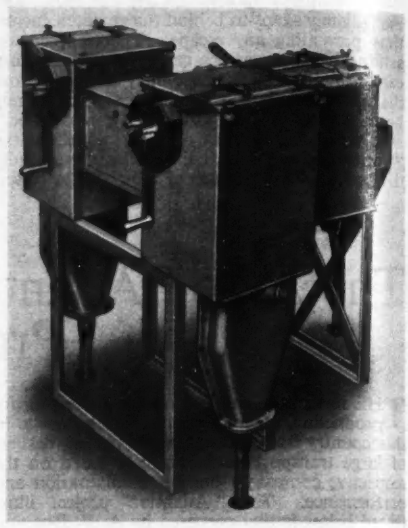
11kV Outdoor Fuse Switch Ring-Main Unit

OUR illustration shows an 11kV outdoor fuse switch ring-main unit made by Ferguson Pailin, Ltd., Higher Openshaw, Manchester, 11. This equipment was on show last week at the exhibition held at Torquay in conjunction with the British Electrical Power Convention. The ring-main unit is a new addition to the company's range of switchgear and comprises a type "OFS" oil-immersed fuse switch which can be fitted with two cable boxes and mounted individually, or alternatively can be fitted with ring main oil-immersed switches on each side as exhibited.

The equipment has a three-phase short circuit rating of up to 250MVA at 11kV, the fuse switch having a current rating of 200A and the wing oil-immersed switches 400A. Extensible and non-extensible designs are available. We learn that the fuse switch has been tested in accordance with the appropriate test duties of Supplement No. 1 to A.S.T.A. Publication No. 8. The tests were carried out using fuse links manufactured by Electric Transmission, Ltd., Stoke-on-Trent.

The "OFS" fuse switch itself consists of a welded steel tank with a hinged access cover and is supported on a fabricated angle iron framework. The fuse links are contained in tubular carriers with contacts at each end, the three-phase assembly being operated by a self-contained spring-loaded mechanism. The fuses are closed on to the fixed contacts by a handle on the right-hand side of the switch tank. Operation of any fuse actuates the tripping levers and opens all three phases. Interlocks are provided so that only with the fuse switch in the "Off" position can the hinged cover be opened, when the fuse carriers protrude through apertures in the earthed metal screen to permit inspection of the fuse links and upper contacts. The mechanism is held tripped when the cover is open. After operation of a fuse link any attempt to reclose before replacement of the "blown" link will trip the mechanism before the switch makes contact. The fixed contacts are carried on bushings which project into the cable box, the latter being attached to the tank and fitted with a gland plate and removable cover.

The oil-immersed switches mounted at each side of the fuse switch are of quick-break design and are operated by a captive handle; the associated mechanism can be locked in the "On," "Off" or "Earth" positions, each of which is indicated on the mechanism casing. The operations from the "On" to the "Off" and from the "Off" to "Earth" positions are arranged to take place over the same arc of travel by disengaging and relocating the operating handle, thus preventing inadvertent operation from the "On" to the "Earth" position. Interlocks are also fitted to prevent the test orifice cover being opened with the switch in any position other than "Earth." Opening the test cover does not remove the cable earth, but locks the switch in the "Earth" position. A current/potential testing device is provided which, when inserted, allows the switch to be operated only to the "Off" position, automatically locking the device in the spouts and connecting it to the cable contacts.



11kV Outdoor Fuse Switch Ring-Main Unit

Gas Plant at Berwick-upon-Tweed

ON Tuesday last a new gas-making plant consisting of nine intermittent vertical chamber ovens was officially opened at the Berwick-upon-Tweed works of the Northern Gas Board. The main contractors for this plant were Gas Chambers and Coke Ovens, Ltd. The nine chambers are arranged in three beds which form the retort bench, and each is heated to approximately 1300 deg. Cent. by the combustion of producer gas made in three producers built integrally with the chambers. Air for combustion is preheated in a recuperator by the products of combustion on their way to the main chimney.

The retort bench is built of silica and firebricks and is supported on a suitably braced steel structure. Each chamber holds 2·3 tons of coal and, depending on the temperature in the chamber, will carbonise this coal in twelve to fourteen hours, producing coal gas at a calorific value of 540 B.Th.U.s per cubic foot. At the end of the true carbonising time, steam is introduced into the bottom of the chamber and passing through the hot coke forms water gas having a calorific value of about 300 B.Th.U.s per cubic foot. This steaming process allows the calorific value of the gas leaving the retort house to be adjusted to 475 B.Th.U.s per cubic foot. In addition, the rich coal gas can be diluted with some of the producer gas used to heat the chambers. The volume of gas made at 475 B.Th.U.s per cubic foot can be adjusted to the needs of the consumers by suitable combinations of the true carbonising time, steaming time and volume of producer gas added.

Electricity for Agriculture*

By C. A. CAMERON BROWN, B.Sc., M.I.E.E.†

The importance of an increased agricultural productivity is emphasised and a case made for considering a general state of "high-farming" necessitating the morale and material support of an accompanying "high-electrification" of British agriculture. A general analysis is made of the potential electrical consumption on, and revenue from, a totally electrified agriculture in England and Wales.

THERE has been much controversy in agricultural circles during the past few years on the pros and cons of "high-farming." To one on the fringe of the area of debate—sometimes dispute—the term could most simply be regarded as covering a stepping-up of the productivity of the farm to make it yield the maximum output of food irrespective of relative profit, in contrast to "low-farming," which operates to produce a reasonable profit with minimum investment; admittedly this is a simplification of the true position. It is probable that "high-farming" tends to be more particularly the role of the medium and smaller farm in the warmer and wetter areas, and "low-farming" more probably the role of the large farm in the drier areas, although the example given by Roland Dudley is of "high-farming" indeed in a fairly dry area and on a large scale. There can, however, be no ignoring the signs that a greater degree and wider spread of "high-farming" is necessary if we are to improve substantially our food and agricultural economy.

Any attempt to apply "high-farming" on a general scale—towards producing in Great Britain a "high-agriculture"—will call for a sustained effort and a higher standard of application by thousands of farmers. Mainly, too, since they are in the majority, this effort will have to be applied by the smaller farmers and not least by those on the marginal lands. There can, indeed, be no high farming without "high-application." No such general upgrading is likely—or likely to be sustained—unless the standard of farm living and working is raised. There can surely be no ignoring the fact that the single factor most likely to raise the standard of living and general morale on a small, and possibly isolated, homestead, is a supply of electricity and all the amenity and comfort which it brings, quite apart from the aid to farming which it more directly offers. Electricity can do more than anything else to settle a man, farmer or worker, in his job—more important perhaps is the settlement of his wife in a farm home or cottage.

It is most unlikely that recruits of the required calibre will be attracted to a life and career based on a paraffin and candle existence. It is equally unrealistic to expect existing farms to develop their own "high-farming" potentialities without the hard core of moral support and labour saving afforded by electricity; without the concomitant of "high-electrification."

This basic requirement in agriculture is widely recognised in all settled and developed countries. What are we in Great Britain doing towards meeting it?

The Supply Position

In any international ranking list of rural electrification achievement Great Britain must, indeed, take a humble place. While the term "rural electrification" does, of course, cover a wide range of interests, from the village rectory to the hillside quarry, the general focus of public attention is the farm, and the criterion of success or failure is the degree to which the country's farms are given a supply of electricity. In this scale of evaluation of our efforts we make but a poor showing. While the other developed countries of Europe are concerned with their difficulty in connecting the outstanding 20 per cent, 10 per cent or even 5 per cent of farms still unsupplied, we have to face the Minister of Agriculture's statement in the House of Commons on October 21, 1952, that in Great Britain some 126,000 farms then connected represented 36 per cent of the total farms listed.

Looking more particularly at the region covered by the B.E.A. and Area Boards, the returns to December 31, 1952, showed 126,623 farm holdings as then being connected. What this really represents in proportional accomplishment is not clear, since it has not been established just how many of the country's agricultural "holdings" do indeed include electrifiable premises; sometimes there are no premises or two or more holdings may be worked from one set of buildings. A pointer to the real position is afforded by surveys carried out by some of the Area Boards, which indicate that only slightly over 80 per cent of the total holdings in their areas taken together have electrifiable premises. Applying this proportion to the whole region, the connected farms would then represent about 40 per cent of the electrifiable holdings.

On the other hand, some Area Boards do not return as "farms" these connected holdings under 5 acres, thereby excluding many of those on the fringe of towns, generally easily—and often actually—supplied and many of them being market gardens and nurseries with considerable potentialities as consumers. Although the true figure of percentage connection may therefore be higher than 40 per cent, and may possibly be as much as 50 per cent, we are still a long way from the point of having anything to be proud of in terms of absolute achievement.

If the percentage of connection be regarded as a criterion of national result in rural electrification effort the same yardstick might equally be applied to the results in different Board areas. Here the figure, subject to the same general qualification already referred to, varies from as low as 14 per cent to as good as 60 per cent of apparent potential connections (there is, of course, the 100 per cent achievement of the London Board!) But while not all of us can really assess the respective national difficulties of other countries, most of us have some idea of the differing characteristics between one Board area and another in our own country. It must, for instance, be expected that the prosperous farming lands of Leicestershire and Nottinghamshire, with the economic uplift of coalfields and industries to assist should be an easier proposition than, say, North Wales or Cornwall, or even, indeed, Cambridgeshire and the Fens. The allocation of Board territory was, of course, substantially directed towards a redress of this unbalance in sections of the country.

There is, of course, another side to the picture. Some of these other European countries have suffered no war; some have used curious devices—grants, subsidies, co-operative schemes, low-interest loans—to reach the happy end; one, at least, has enjoyed Marshall aid. We, on the other hand, have done none of these things, other than a trivial toying with one or two grant-aided schemes; perhaps our major mistake was in not having done more in this way. But, against this again, is the fact that we are regarded as one of the more advanced nations of the world—the leader in shipping, a leader in engineering generally and electrical engineering in particular, a compact country, a country with an early interconnected transmission scheme which was the envy of other countries, and now with a smooth nationalisation scheme which is openly and widely admired, if not, indeed, envied by some. Is it to be wondered at, therefore, that nationals of other European countries regard our figure of farm connections first with expressed disbelief and, on confirmation, with a puzzlement tinged with something akin to awe?

The general problem of rectifying this situation is dealt with in the opening paper, in which Mr. Steward points to a number of directions along which the full solution must be sought. I propose to underline the specific importance of affording an electricity supply to all farms, a matter regarded in other developed countries as one of primary and urgent importance. I shall, too, try to make a case for regarding the electro-agricultural load as potentially self-supporting or largely so and certainly as something much greater in potentiality than might be inferred from present-day consumptions and revenues and from some expressions of pessimism.

The Technical Position

There is at least one brighter side to the picture of British farm electrification when compared with other countries. In technical application and depth of penetration our farm electrification is second to none; indeed, it has been made very clear to me during recent months that in certain respects we are substantially in advance of other countries. I can trace no record elsewhere of anything approaching our applications of electricity to farm milk production, either in extent of use or in our versatility of development; nor of our wide use of electricity in crop-drying, the only comparable effort in all-electric grass-drying in Switzerland being entirely and peculiarly dependent on very special circumstances of electricity supply. In all the more general power processes in and about the farm we are equally well up in the forefront of progress.

It is not only that we have applied electrical methods to farming with some degree of activity and penetration, but we have developed those electrical methods on lines most suited to our methods of rural distribution. It is common practice on the Continent to supply rural areas through heavy medium-voltage lines radiating in all directions up to 3 miles and even 5 miles from a comparatively large substation, possibly feeding up to twenty farms or more in addition to villages, &c. In Great Britain, particularly during the past fifteen years, it has become more general to carry the h.v. distribution, or a h.v. spur, close to the consumer, so that the transformer may be supplying no more than a couple of farms with associated cottages; there must indeed be thousands of instances of one farm to one transformer. This practice has been accompanied—indeed facilitated—by an increasing use of single-phase supply, mainly carried out by means of the "E.R.A. line," devised to cheapen the cost of rural distribution and covered by B.S. 1320. Thus, while the European operating problem is largely one of voltage losses, ours is one of transformer losses and the higher "per kVA" outlay. Our distribution engineer must, therefore, attempt to keep each of this multitude of transformers as small as possible, a result which has the doubly satisfactory end of reducing both total losses and capital outlay. While realising all this, the distribution engineer is, in the end, at the mercy of the commercial engineer, who has to build up the load and the revenue to which all the earlier activity leads.

The Changing Scene

Some fifteen to twenty years ago—a period of agricultural depression—such farm grain grinding as was done was by machines taking from 7 h.p. to 15 h.p.; with the gradual recovery of British agriculture the tendency was to introduce the American type "hammer-mill" taking up to 20 h.p. and even 30 h.p., not a comforting prospect for either the distribution engineer with his transformer in mind or the commercial engineer trying to sell a 20 h.p. single-phase motor! By 1942, as a result of E.R.A. experimental work, it became possible to do by far the bulk of farm grain grinding in this country by means of a small 3 h.p. automatic hammer mill, working on either time or quantity control and requiring no supervision during running. By now there must be in use in this country something over 8000 of these mills, mainly in two makes. As an example of the significance of this can be quoted one sub-area with over 1000 of these mills now installed, with a consequent reduction in demand estimated as at least 2000kVA and in demand charges of some £8000 per annum, as well as of unspecified savings in plant and line costs.

Steam sterilisation on dairy farms is one of our best sources of rural revenue. Until the end of the war this called for electrical loads of from 4kW to 9kW where bucket machine milking or hand milking was practised, and from 12kW to 36kW where recorder milking plant was used—again a poor prospect for a transformer-conscious economy. Now, some eight years later, practically no equipment of this kind is sold, it being almost invariable to use storage steaming units, which, with a small heater loading, quietly build up a reserve of heat, which is converted immediately into steam when sterilisation is carried out. The steriliser requirements of most of the dairy farms in Great Britain can now be met by "hot block" chests of 1kW loading, and the largest requirements, hitherto calling for up to 36kW, are satisfied by 2kW or 3kW. There is, too, the "water storage" steam raiser, in which the steam availability is slowly built up as "superheated" water, and which in loadings

* Paper, British Electrical Power Convention. Torquay. June 11, 1953.
† British Electricity Authority.

from 3kW to 9kW is particularly suitable for conditions where the calls for steam are rather less straightforward.

While I have no such clear illustration for the operational gain from these developments in storage steam raising as is available for hammer-mills, the gain overall is probably even greater. After all, a 1kW hot block generally replaces—or prevents the connection of—6kW to 9kW : a 2kW hot block almost always ousts 18kW to 20kW or even as much as 36kW on occasion.

Grain drying is a comparatively new growth in British agriculture, called into being by the "combine" harvester thresher, and, with it, revolutionising our home food production. Until the end of the war grain was dried on farms by equipment which, if heated electrically, called for loads of from 150kW to 300kW. Astonishingly perhaps, a number, possibly a dozen, of all-electric driers covering this range of loads were installed and worked satisfactorily, but anything other than rare installations of this kind could hardly be regarded with equanimity. But here again, technique has progressed and nowadays, with more grain than ever being dried, it is but rarely that a dryer of this type is installed and never as an all-electric machine. Modern grain-drying is mainly carried out in two quite different ways. In one, generally for the large farm, the grain is put direct from the field into large bins or silos, which have porous floors through which slightly warmed air is blown, and thus upwards through the grain. This "in-silo" method involves not 150kW, but heat loadings in the main up to 20kW or so, and fans of 7 h.p. or so. The other modern method, an adaptation of a very old one, is the platform drier, whereby grain is dried in sacks each laid over a hole in a platform covering a plenum chamber, into which warm air is blown and thence through the sacks. This method is generally more suited to the smaller grain-growing farmer, and involves heater loadings usually of from 5kW to 25kW and fan power of from 180W to 3½ h.p. In this case it is not a matter of avoiding larger loads, since few of the older type of all-electric dryer would have been put in, but rather of opening up an entirely new field of electrical revenue while yet avoiding unduly high load demands. At the same time, all this modern grain-drying load can be kept to the off-peak months or, during winter, to night running only.

The drying of fresh cut grass to produce a high-protein and valuable feed, or feed component, has long been an accepted practice in this country of such good grass growing potentiality. The use of electricity to provide the drying heat is quite out of the question since, the moisture evaporation being considerable, the loads would be high—at least 250kW—and the cost of any conceivable tariff would be prohibitive. Grass drying does, however, offer quite attractive power loads, mainly in spring and summer, of up to 100 h.p. and over, with up to more than 100,000kWh consumption per installation. In any case, grass-drying proper is a highly specialised process more suited to the largest class of farm and more usually worked on a group or co-operative basis ; attempts to apply it on a smaller scale to individual farms may result in a product far removed in quality from the proper grass-meal. There is more hope for the individual and smaller farmer in "barn" hay-drying which is a cold-blowing process for securing "super-hay" and involves long period blowing by a fan of some 3½ h.p. Later investigations are towards making the process more precise and predictable by finishing it by a short spell of heated-air blowing ; some "field" demonstrations of this idea have been carried out by the North of Scotland Hydro-Electric Board, but these involve up to 100kW of heating whereas we are not without hope that experimental development now in hand will result in calls for only some 10kW to 20kW for the purpose.

Thus, and in other less important ways, the requirements of the distribution engineer—low demand and low transformer losses—and of the commercial engineer—revenue—can be reconciled. The "average" dairy farm not drying grain could fit its pumping, milking, cooling, sterilising, hot-water, grinding, hay-drying requirements within an m.d. of some 5kVA, offering a consumption of 9000kWh per annum or at an average of say 1·5d. a revenue of £56. At the same time, not only have one time severe loads in a rural transformer been radically reduced, but the form in which they appear is such that they can mainly be kept off the major winter peaks and therefore deserve the special tariff concession, which some Boards are offering.

The Electrified Farm

In any discussion of rural electrification the question will arise as to just what the farmer does with electricity—is this urgency of supplying him, which is being raised here and elsewhere, a matter of economics—or one of ethics ? Is it to the good of the country—or of the farmer alone—to the vital working of the farm—or to the amenities—that demand for supply is made ?

In suggesting that electricity cannot at present be expected to play a part in the basic "agricultural" processes, I am referring to agriculture in the common and narrower sense of the term, i.e. to "farming" and not including horticulture where the balance of significance is quite different. While therefore electricity cannot be credited with even a secondary role in the major agricultural processes it can be given credit for playing a major role in the secondary farm processes—so much so, indeed, that after an initial hold up in rural electrification at the beginning of the war, activity resumed when it was realised just how helpful electricity could be to farmers—particularly dairy farmers—working to a maximum effort.

And it is, indeed, the dairy farm which owes most to electricity for its modern progress in technique towards economical and high grade milk production. Modern milking machine developments, in particular the "milking parlour," have greatly increased the number of cows handled, and amount of milk produced, per worker. While such machines are electrically driven where possible, this role of electricity is quite secondary to its great contribution to the facilitating of cleanliness and hygiene with minimum effort. The cutting to the minimum of the labour force for milking would be poorly received if these workers had to carry out the associated tasks of washing and sterilising the equipment by old-fashioned methods. Electrical water-heating and steam-raising has enabled the two sides of the job to be kept in balance. Of course, again, no effort at upgrading the tempo and quality of milk production, or handling, can be really successful without adequate lighting and that electricity alone can give ; if it had made no other contribution towards optimum milk production, the blessing of "light" would have been worth while, although hardly on its own a revenue-earner of any substance. The milking machine, too, is but a modest revenue-earner—at 30kWh or so per cow per year, the common twenty to thirty cow herd will use only between 600kWh to 900kWh. But the supply of hot water and steam can account for most substantial consumption ; a twenty-cow herd with bucket milking plant might reasonably use each year some 4000kWh for water heating and 2000kWh for steaming electrically.

But possibly, on many farms, the most valuable asset from an electricity supply is the transforming of a source of water—well, spring, stream—into a service of water—water "on tap" at adequate pressure and automatically—above all, at reasonable prices, for the conditions are exceptional indeed if electrically provided water costs more than 9d. or so per 1000 gallons, whereas publicly supplied water is rarely less than double this figure and commonly much more.

The Farming Gain

But what does all this amount to in terms of gain to the farmer in return for the money he spends on electricity—or, perhaps, more important still, for the outlay of national capital and resources in affording the supply ? Is this to be regarded as national expenditure or as national investment ?

It is well to be able to crystallise the aims, objects and results of farm electrification, and there is no great difficulty in assessing for any particular farm what order of gain to the farm management and operation is so afforded. Here again might be taken our "average" milk producing mixed farm. Leaving aside not only amenity value but such very tangible assets as the reduction of dirt-provoking services and the provision for the first time in farming of adequate light, the assessable main gain from electrification must be in terms of labour saving—or perhaps better, labour-freeing. It is then up to the farmer so to manage the farm as to make productive use of the working-hours gained ; if he cannot so manage he is not a potential "high-farmer."

For, therefore, such a farm of some 75 acres we have assessed a schedule of minimum saving by using electrical methods, as follows :—

	Man-hours per week
Water-heating and sterilising	3·5
Milking	1·75
Lighting	1
Grinding	3
Hoisting	1
Mixing	1
Water pumping	1·75
Chick hatching	1·75
Chick rearing	1·75
Food cooking	1·75
Egg production	3·5
	21·75

Such a schedule will be regarded by many of my colleagues in the field as an under-statement and it is indeed a conservative estimate—a "bare" assessment. These time-gains are considered to be only those most reasonably assessable and to them might be added such unassessable gains as those afforded by having even simple workshop tools, thus saving journeys to the blacksmith, and the actual speeding up of operations, even walking from one part of the farm to another, afforded by electric light ; nor again has the time-value of small grooming machines or the effect of good light in handling stock, particularly in sickness, been assessed.

The bare assessment itself, however, amounts to 1131 man-hours saved per year, or allowing for some sheer job-softening, say, 1000 man-hours or twenty weeks' work.

This saving may be enjoyed by some farmers as meeting a problem of dearth of available labour, and by others as enabling them to avoid engaging further labour which could not be wholly employed, but mainly it will mean the freeing of labour for other work on the farm. At the figure of £5 per week for one worker the saving has a cash interpretation of £100 per annum ; regarded more constructively this freed labour, if applied at the national average could result in an increased productivity of some £300 per annum. And this as a result of operations calling for an expenditure of the order of £50 to £60 on electricity !

There are, of course, other gains to be enjoyed by a farmer with electricity available. If he keeps pigs, then the electrical method of rearing will save, on average, one pig out of every winter litter—in all some 225,000 pigs or 76,500,000 weekly bacon rations for the country—this would supply the whole of the population of the South Western Board's area with their bacon ration for nine months !

Taking another line, modern intensive egg production is dependent on electricity for its being ; under the earlier system one man can with some effort, look after 1000 birds, whereas with modern electro-mechanisation, using cafeteria laying batteries, he can attend to from 3000 to 4000 birds. If electrically operated automatic feeding and watering be applied to the deep-litter system one man could look after 5000 birds ! Artificial lighting of laying birds on any system of housing will increase the vital winter egg production by from 20 to 30 per cent. There is, too, the sign that the American "broiler" system of table bird rearing may develop here into affording a major source of our "meat" supply. Involving as it does the *en masse* keeping of birds up to about twelve weeks under intensive conditions, this again is almost necessarily dependent on electricity for brooder heating, space heating, automatic feeding, artificial lighting of the buildings, and their automatic ventilation, food mixing, &c. Chick sexing by electric light has made this an exact art and the use of equipment costing some £30 to £50 can save a large hatchery up to £1500 a year.

But possibly a major contribution of electricity to the small to medium farmer is that he can

now install and use a grain dryer on a small scale and at a cost well below that offered by any other method. The small all-electric platform dryer costing some £100 as compared with from £250 to £400 otherwise, has now made it practicable for the small "average" farmer to enjoy the advantage of combine-harvesting by contract without the dangers existing if he had no dryer. That there are now some twenty such dryers in Cornwall—a wet county of small farmers—is demonstrable proof of the success of this development.

High Electrification

With not more than 40 per cent of our farms connected, British agriculture cannot be regarded as being within sight of a general state of high-connection. The mechanism towards rectifying that situation is discussed in the opening paper and certain aspects of this will be taken up later. But my more immediate concern is with the more discouraging fact that we can hardly consider our already connected farms as a whole to represent a state of high electrification within themselves. The average farm consumption during the year 1951–52 in the region served by the B.E.A. and Area Boards was 4700kWh, showing at the average price of 1·339d. per kWh an average return of some £27. Since an ordinary house equipped with cooker, water-heater, &c., may easily reach such an annual consumption, we can only conclude that of the many technical advances and advantages afforded by electricity only a fraction have reached the farming world as a whole. And this is, of course, a hard and inescapable fact, known to many of us from personal experience. Those who are intimately concerned with the application of electricity to farms and farming can feel little but technical disappointment on this score; those who have striven to give supply, and to manufacture modern and advanced equipment, must equally be disappointed at the apparently small appreciation of all their efforts.

If we take that elusive thing "the average farm" as being one producing milk from a twenty-cow herd with all the associated crop growing and stock rearing—the backbone of agriculture, the mixed farm—we know that we could reasonably expect something of the order of consumptions shown in Table I. This shows a total revenue of £100 to which might, and generally could, be added say two worker's cottages at from 5s. to 10s. each per week, say, together some £40 per annum. Thus, the total from the farm group, regarded presumably as one "farm connection" could be very reasonably some £140 per annum. And there are farms of this category reaching consumptions and revenues of this order! There are well electrified but large farms using more, and smaller farms using less; but the majority of farms are far from using an optimum quota. Why is this so?

Table I—*Electricity Consumption for "Average" Dairy Farm*

	kilowatt hours	kilowatt hours
Domestic	5,000	—
Farm:		
Lighting	400	—
Water pumping	300	—
Milking-machine	600	—
Water heating	3,600	—
Steam-raising	1,800	—
Cooling	600	—
Grinding, Mixing, Hoisting	300	—
Hay-drying (off-peak)	—	2,500
Grain-drying (off-peak)	—	2,000
Total	12,600	4,500

The total of 12,600kWh at an average of, say, 1·5d. would yield some £79 per annum; the off-peak drying consumption at, say, 1d. per kWh would come to about £19, making a total of £98, say £100.

It cannot be due to the cost of electricity. A farm of this size might have a gross income up to as much as £10,000 per annum; even such a farm not exerting the highest effort would expect not less than £3000 per annum. Is it seriously suggested that an item of £100 or so could be regarded as a prohibitive charge? A more probable deterrent factor is the capital cost of the equipment, which might well amount to some £1000 for the "sample" considered; this is certainly a point which has to be considered and may be met, by lower priced equipment, hire purchase, or even hire. But the main factor depressing the expected revenue from fully electrified farms is generally the absence of any outside drive or urge. We live—and the farmer lives—in a world of salesmen, and no less must the all-electric idea be sold to the farmer—or it must be forced on him, e.g., by a guaranteed minimum revenue or by line rentals. A combination of both is probably the solution.

There are clearly, therefore, two problems to be solved in attempting to achieve a state of high-electrification in the agriculture of Great Britain. First, the effecting of supply to all farms and agriculture holdings with electrifiable premises; secondly, the increase of electrification to the point of saturation and high revenue on every farm so connected—now and later.

Supply

In attempting any examination of electro-agricultural potentialities within the United Kingdom I am hampered by the existence of three separate electricity supply organisations and three separate and non-coincident channels for collecting agricultural statistics. I propose, therefore, in making a brief and broad picture of the position and proposition to concentrate on England and Wales.

In England and Wales at December 31, 1952, the number of agricultural holdings returned as being connected was 118,066. Applying the average consumption per farm of 4600kWh and the average cost per kWh of 1·34d. shown for 1951–52, the total farms now connected would show a gross annual return in round figures of £3,000,000; we might give the term "basic farm revenue."

Proceeding from there and by a process of analyses in steps, which would appear to be neither profitable nor necessary to give here in detail, has been assessed the potential consumption from all the electrifiable farms in England and Wales provided (*a*) all the now unconnected farms or agricultural holdings were connected, (*b*) that these were each and all developed to a state of high-electrification, (*c*) that each and all of the farms now connected and not in a state of high-electrification should be made so. The making of this total assessment was done partly in steps by farm classes as is done for the twenty-cow farm in Table I, and partly, in other matters, by total national assessment.

Table II

	kWh per annum	New equipment sales	Extra connected load
	Million	£ million	MW
Water-heating	700	2·5	275
Steam-sterilising	200	4·75	150
Milk cooling	100	5·5	10
Water-pumping	100	5·25	50
Grinding	10	1·5	60
Grain-drying	300	5·0	600
Grass-drying	500	5·0	800
Poultry-incubation	20	—	7·5
Poultry-rearing	100	—	100
Pig-rearing	50	0·1	17·5
Total	2080	29·6	2069·0

As a result of all this I estimate the total possible consumption from a 100 per cent connection and a 100 per cent electrification of all the electrifiable farms in England and Wales to be some 2000 million kWh, as shown in Table II, which also includes assessments of associated equipment sales, and of additional connected load to that now applied. These figures are large, but are not unrealistic; they are, however, conditional on the following assumptions: All dairy farms will have water heaters; all dairy farms over ten cows will have electrical steam sterilisation; farms over twenty cows will have a milk cooler; one-third of all dairy farms will pump water; 20,000 small hammer mills will be installed; number of combine harvesters will be doubled by 1963; half of all grain dried electrically; that 10 per cent of all grass now grown for hay will be dried electrically on the farm, not including specialised grass drying plant; all chickens hatched reared electrically; all winter pig litters use infra-red rearing.

In assessing revenue the farm grain-drying and grass-drying might be regarded as meriting off-peak rates of, say, 1d. per kWh; this at 800 million kWh amounts to £3,000,000. The remaining 1200 million kWh at, say, 1·5d. would amount to £7,500,000. There is, too, a quite reasonable expectation from the 300,000 farm-houses and 200,000 farm cottages in the country of a total revenue of roundly £12,000,000. The total revenue from farm holdings in England and Wales when all practising the policy of high-electrification would therefore be roundly of the order of £23,000,000 per annum.

The above general analysis of farm consumption has been applied only to those farms of 5 acres and above, the debatable ground of the under 5-acre group of some 70,000 holdings not being included, except roundly for domestic consumption. But many of these may have been included in the general assessment of poultry requirements and many will also be market gardens and nurseries; the potential place of horticultural electrification is dealt with in the paper following this, but from it I take the figure of some 800 million kWh as consumption and at an average of 1·5d. per kWh a resulting potential revenue of some £5,000,000.

Thus we have an overall picture, not including many of the smallest class of holding, of some £28,000,000 as a potential revenue from a highly electrified agriculture in England and Wales. There is no reason to believe that similar considerations would not apply in that part of Scotland covered by the two Area Boards, although the general picture presented in the Hydro Board area would probably be rather different.

From this "global" assessment of potential farm income of £28,000,000 for England and Wales might be deducted the present total income—or "basic revenue"—of £3,000,000, which may be regarded as covering existing outlay on farm connections. This leaves the sum of £25,000,000 which might be attained as a reasonable minimum revenue, when highly electrified, from all farms not yet connected together with the extra revenue from farms now connected but not yet fully electrified. No recent overall estimates are available as to the additional capital and other costs in which the Area Boards would be involved in connecting all the outstanding farms—the situation changes from month to month as more of the work is undertaken—but clearly a potential revenue of this order of magnitude merits considerable efforts to secure.

Industrial Glass Works Extensions

Extensions recently completed at the works of Quickfit and Quartz, Ltd., at Stone, in Staffordshire, have added a further 25,000 square feet of production area to the factory. This works specialises in the manufacture of interchangeable glass laboratory apparatus and large glass equipment in standard forms and sizes to suit most industrial requirements. The company was formed some twenty years ago as part of the Triplex group, and it was moved to Stone in 1946 owing to space limitations at the parent works.

The laboratory glassware with interchangeable conical ground joints is produced from glass tubing and flash mouldings. Industrial glass equipment is made up from glass tubing, blown mouldings and glass pressings, fused together in various combinations. For sealing together the large diameter and heavy articles a special design of butt sealing lathe is used. These lathes have two headstocks driven at the same speed, one headstock being fixed and the other slidable along the machine bed. The two glass parts to be joined—such as a glass tube and a pressing—are mounted in suitable chucks in the two headstocks and as they rotate the ends are heated to a fusion temperature and brought together.

A recent development in this class of machine is the introduction of what is known as an electric welding process, whereby the ends are heated to fusion temperature over a small area by electrical means. This process is based upon the fact that above a temperature of about 350 deg. Cent. the insulating properties of borosilicate glass decrease and its conductivity increases as the temperature rises. By using gas burners to preheat the area of glass round the ends of the two units, and then using these burners as electrodes, a flow of current is used to raise rapidly the glass temperature to fusion point. The quick local heating of the glass made possible by this process considerably speeds the joining operation.

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LOSS OF THE "PRINCESS VICTORIA"

Shortly before the war "Historic Accidents and Disasters" formed the subject of a series of articles in this journal. Readers of those articles will remember how, as the story of the events prior to each accident was unfolded, the tension built itself up and how, in retrospect, disaster could be seen to be the wellnigh inevitable end. Little art and no embellishment, only clarity, was needed to make the facts themselves tell a gripping story. From the beginning, as from the first act of a Greek tragedy, the end seemed foredoomed. Nor, each time, were there lacking black auguries—auguries that were apparently disregarded by those involved in the tragedy. The instability of the "Captain" had been calculated before she turned turtle in the Bay of Biscay on September 7, 1870; the Tay bridge swayed dangerously in high winds before, one stormy night in December 1879, it fell, carrying a trainload of people to their deaths; the chafing of the gas-bags of the airship "R101," against which ineffective remedial action had been taken, led to her destruction upon a French hillside near Beauvais in 1930. So, too, in retrospect and in the light of the evidence given at the inquiry does the British Railways cross-channel motorship "Princess Victoria" seem to have been foredoomed to founder in no more than an ordinary gale. As with earlier disasters, those responsible are seen, again in retrospect, to have paid insufficient attention to auguries. Like the characters in Greek tragedies, they seem to have been bereft of the power to realise the danger and blinded by the Fates. When at about 7.45 a.m. on the morning of Saturday, January 31st, the "Princess Victoria" sailed from Stranraer to make the crossing to Larne, no one imagined, though the weather was stormy, that in a few short hours the ship would be overwhelmed by the seas and sink with heavy loss of life. Yet, as has since been revealed, there had been warnings that she might, that sooner or later, unless action was taken, the ship was foredoomed to sink.

The "Princess Victoria," which operated the Scotland-Ulster service with the "Princess Margaret," had a length between perpendiculars of 305ft 6in by 48ft moulded breadth by 28ft 6in depth to the promenade deck, and a gross tonnage of 2694 tons and was propelled by twin screws driven by diesel engines developing a total power of 5100 b.h.p. As a consequence of the sinking of this comparatively new ship (she was built in 1946), with the loss of 133 lives on the relatively short crossing of 24 miles of open sea, a court of inquiry was set up under the Merchant Shipping Act, 1894, by the order of the Minister of Transport. It was conducted by Mr. J. H. Campbell, Q.C., assisted by three assessors, and it exhaustively investigated every aspect of the foundering of the ship. Evidence was given by members of the crew, builders of the ship, Ministry of Transport officials, representatives of owners, coastguards, officers of Lloyd's Register of Shipping, the Royal Air Force, and those concerned with communications, to establish the facts relating to the disaster and to provide answers to questions set down by the Ministry of Transport. The findings of the court after considering all the evidence were issued in a report given in Belfast on June 11th, over the signatures of Mr. J. H. Campbell, Q.C., sitting as judge, and his three assessors, Captain C. V. Groves, Professor A. M. Robb and Mr. J. Shand. In the report the Belfast tugs were absolved from any blame and both the builders, Denny Brothers, Ltd., and Lloyd's Register of Shipping, were also absolved from any responsibility for the loss of the ship. Although it was recorded that liaison between the wireless station and the coastguard was not fully effective, the blame for the loss of the ship was placed by them wholly upon the owners of the ship, the British Transport Commission, and the managers of the ship. That decision was based upon evidence which showed the ship to be unseaworthy on two major counts, namely, the inadequate strength of the stern doors and the inability of the scuppers to clear the car deck rapidly of any large quantity of water which might find its way on board.

As from the disasters of the past there will be lessons both organisational and technical to be learnt from the loss of the "Princess Victoria." One of them clearly is that it is unsafe to assume in a ship with rear doors that they will never be damaged or overtopped by heavy seas; and that a second line of defence should be available in the provision of adequate scuppers to drain the space confined within the doors. Another appears to relate to the management and control of seagoing vessels. The court was of the opinion that "the evils of remote control were apparent in this case." For if "the master required advice or assistance from a higher authority it was necessary for him to get into telephonic communication with the head office at Euston some 400 miles away." Amongst other organisational arrangements held to be defective, "there was no one in the whole organisation whose sole duty it was to look after the well-being of the structure of the ships." As a consequence of those strictures the British Transport Commission is now no doubt investigating the adequacy of its organisation for that relatively small part of its affairs concerned with cross-channel services. Those who died in and around the sinking "Princess Victoria" will not have died wholly in vain if the technical and organisational lessons to be learnt from the disaster are applied, as, we have no doubt, they will be applied. Not only is no ship again likely to sink in similar circumstances. All ships that are structurally similar will be designed in future with the fate of the "Princess Victoria" in mind; and, no doubt, the design of all ships of similar character now in service will be critically investigated for similar weaknesses. Nor will organisational lessons go unheeded by all those concerned in the operation of ships.

ROAD SAFETY

Few remarks by a politician can have riled engineers more than that which Mr. Gurney Braithwaite, Parliamentary Secretary to the Ministry of Transport, made when opening a road safety fête at Uxbridge recently. "Safety on the roads," he is reported to have said, "is not achieved by legislation or large capital expenditure, but by the exercise of intelligence, road knowledge and courtesy." The occasion, of course, can be pleaded in extenuation of that remark. No doubt Mr. Braithwaite wished to stress at such an affair that more careful human behaviour could contribute to road safety. Yet, in fact, he expressed an opinion which road engineers will deem almost the opposite of the truth. Nor does it make very much difference if he prefaced the remark by the phrase "In the last resort. . . ." For "the last resort" upon British roads is very distant. Road engineers know by experience that safety on the roads is not, in present circumstances, greatly influenced "by the exercise of intelligence, road knowledge and courtesy," but that a large reduction of the number of accidents could be brought about with certainty only by road improvements. Indeed, it is not the habitually aggressive or careless road user who is mainly responsible for accidents. By far the majority of those who suffer them are ordinary decent people

who normally do exercise " intelligence, road knowledge and courtesy." Those people have accidents because it is not within the bounds of human nature never to do foolish, mistaken, rude or aggressive things and because British roads provide a myriad of opportunities for occasional lapses. It follows that there are accidents and that the number of accidents is roughly proportionate to the weight of traffic on the roads, rising in summer and falling in winter.

Of course, Mr. Braithwaite has a difficult task to perform when he talks about road safety. As a member of the Government he has to conform with its policies. But, unfortunately, the Government has reached two mutually contradictory decisions. One of them is that it is intolerable to contemplate any increase in the number of accidents on the roads ; the other is that the country cannot afford at present to spend any money on road improvements. Thus, even in the teeth of evidence to the contrary, Mr. Braithwaite cannot be allowed to admit to more than a very little connection between road safety and expenditure upon road improvements. The public, in short, is to be led to believe that safety on the roads is not to be achieved by large capital expenditure, but " by the exercise of intelligence, road knowledge and courtesy." Unfortunately, as correspondence in the daily and even the motoring Press indicates, many road users do believe it. It is even very possible that Mr. Braithwaite believes it himself ! Yet, transferring his remark to different spheres, Mr. Braithwaite is, in fact, arguing that the installation of interlocked signals and points and many other safety devices on the railways, and the placing of guards round machinery in industry has been a waste of money, since as much safety could have been attained by asking more of the intelligence, knowledge and courtesy of signalmen and drivers on the railways and workers in industry ! In the factory, on the railways, in the operation of aircraft and ships, even in the home, the certainty sooner or later of human misjudgment is accepted. Everything is done, therefore, that can be done to minimise the opportunities for misjudgment and to prevent the consequences of any misjudgment becoming serious. Only upon the roads is the blame laid so completely upon human failure and so little done to right those defects of design that multiply the opportunities for human misjudgment. The desire of the engineer to make roads safer—by a multiplicity of minor improvements and by making new roads more adequate to carry the traffic upon them—is frustrated by the conviction of the Government that expenditure upon the roads cannot be justified in present circumstances.

In defence of its attitude the Government claims that sufficient money is being spent upon the roads to prevent their deterioration. That is a claim that engineers heartily dispute. Yet even if it be accepted that the roads are being adequately maintained in their present state, can that policy really be regarded as satisfactory ? Maintenance, after all, is a dynamic, not a static, business. A road system can only be said to be properly maintained if over the years it remains consistently adequate to carry the traffic upon it. But since the war, even if the condition of the roads has got no worse, their adequacy to carry the traffic upon them has rapidly deteriorated as traffic has increased. That trend must be as obvious to the Government as it is to road users. As the traffic has increased so has the number of accidents. As the traffic increases still further so will the number of accidents increase ; and if road improvements are not soon begun the maximum monthly rate of 21,819 casualties on the road in August, 1951, will become the minimum monthly rate in a very few years' time. In a letter to *The Times* last Tuesday, Sir Arthur Goodhart, of Oxford University, suggested, in view of the conflict of opinion about what should be done, that a Royal Commission should inquire into accidents upon the roads. For ourselves, we doubt the value of that suggestion. It would, we feel, be more to the point if the Government were to become more liberal in financing the work of the Road Research Laboratory and quicker in applying the results of its researches. For that body is acquiring scientifically information about the factors that influence safety on the roads more reliable than any opinions that could be offered to a Royal Commission. Given the financial support it could acquire it more rapidly. Moreover it is acquiring its facts in so sensible, scientific and engineering a way, that there can be no argument about them. It has no preconceived conceptions about the way people ought to behave on the roads ; it merely inquires how, in the mass, they do behave. On the basis of its statistical results valuable conclusions can be drawn about methods of designing safe roads, about methods of modifying old roads so that they shall be safer, and about the national economics of expenditure upon road improvements. Mr. Braithwaite should give more attention to its reports.

Obituary

DR. DANIEL HANSON

WE regret to have to record the death of Dr. Daniel Hanson, which occurred suddenly at his home at Haselor, near Alcester, Warwickshire, on Friday last, June 12th. Dr. Hanson, who was sixty-one, had been Professor of Metallurgy and Director of the Metallurgy Department in the University of Birmingham since 1926.

Daniel Hanson was born at Preston Brook, Cheshire, and was educated at Wallasey Grammar School and at the University of Liverpool. He began his career as a metallurgist in the research department of Woolwich Arsenal, and subsequently he joined the staff of the National Physical Laboratory at Teddington. There, he became assistant to the late Dr. Walter Rosenhain in the Department of Metallurgy, and, later on, was appointed Principal Scientific Officer in the department. In 1926, Dr. Hanson was appointed to the Feeney Chair of Metallurgy at Birmingham University. In his twenty-seven years as Professor of Metallurgy and, later, as Director of the Metallurgy Department, Dr. Hanson was responsible in no small degree for the considerable expansion of metallurgical study and research work which has taken place at Birmingham University. His services as a lecturer on metallurgical subjects were not only valued highly in this country, but also overseas. At different times he had lectured in the U.S.A., Canada, Australia and New Zealand, and in 1950 he was a member of the British delegation which discussed with American and Canadian scientists the release of fuller information about atomic research conducted in the U.S.A.

In addition to his work at Birmingham University, Dr. Hanson took an active part in the affairs of several learned societies and contributed numerous papers to their proceedings. He was a member of the Iron and Steel Institute and a past vice-president of the Institute of Metals.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

PRESENT-DAY LOCOMOTIVE WORKING IN GREAT BRITAIN

SIR,—To keep a sense of proportion any survey of the work of modern British locomotives ought to include some reference to work which has been done on the same railway in the past and, if possible, some reference to the work of contemporary locomotives of comparable dimensions in other countries.

In connection with Mr. Nock's articles on the Doncaster " Pacifics " may I go back to the year 1867 and quote from the description published in THE ENGINEER* of the last engines designed by Archibald Sturrock for the Great Northern line ? It is there stated that the engines were taking trains of twenty coaches between King's Cross and Peterborough in 88 min. The weight of a coach is not given, but I assume that a twenty-coach express of that period would weigh at least 140 tons.

Those who, like myself, remember railway travel before continuous brakes came into use know that lack of brake power made the stopping of a fast train a very gradual process which occupied a considerable time. And modern bogie rolling stock, vestibuled and centre coupled, running on modern permanent way, is said to have substantially less resistance than coaches of an early type. If, therefore, the Sturrock engines had had the advantage of working under modern conditions the 88 min required for the King's Cross–Peterborough journey might have been cut to 84 min, or even less, with trains of the same tare weight. So it appears that as long ago as 1867 there were British locomotives which were capable, under the conditions of to-day, of hauling trains of four times their own weight for long distances over a not very easy road at a start-to-stop speed of 54 miles an hour.

When we bear in mind that the Sturrock engines had none of the aids to efficiency now regarded as indispensable—superheating, high steam pressure, the latest tricks in valves and valve gears, roller bearings, exhaust injectors, rocking grates, the Rugby testing station, and all the rest of it—the result of eighty-six years of progress is not impressive.

As to locomotive work in other countries it has been unnecessary for half a century to look beyond the wonderful French compounds.

W. B. THOMPSON

The Athenæum,
Pall Mall, S.W.1,
June 11th.

Books Received

The Standard Manual of the Slide Rule. By J. E. Thompson. Second edition. London : MacMillan and Co., Ltd., St. Martin's Street, W.C.2. Price 15s.

Ferrous Analysis, Modern Practice and Theory. By E. C. Pigott. Second edition. London : Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 84s.

Engineering and Western Civilisation. By James Kip Finch. London : McGraw-Hill Publishing Company, Ltd., 95, Farringdon Street, E.C.4. Price 47s.

* THE ENGINEER, March 1, 1867, page 181.

Electricity and Food Production

THE part played by electricity in the production of food in Great Britain was discussed by the British Electrical Power Convention at Torquay on Thursday afternoon, June 11th. The proceedings opened with a paper, "Electricity and Food Production," by Mr. S. F. Steward, chairman, South-Western Electricity Board. He dealt with the general problem of increasing rural electrification in this country and examined the lines along which a solution may be effected. He described the methods adopted by his Board and gave some of the results so far achieved. For example, the Board had made a survey, completed in 1951, covering 949 parishes and had brought supplies of electricity to 911 farms in 1950–51, 1174 in 1951–52 and 1279 in 1952–53.

Mr. Steward's paper was followed by a group of three supporting papers dealing with particular aspects of electricity and food production. The first paper, "Electricity for Agriculture," by Mr. C. A. Cameron Brown, is reproduced in abstract form elsewhere in this issue (pages 861–863). It was followed by a paper on "Electricity for Horticulture," by Mr. A. W. Gray, and by a paper on "Electrical Equipment for Food Production," by Mr. F. E. Rowland. The four papers were discussed jointly and a report on the discussion is given herewith.

Discussion

Mr. J. T. Beresford (South Western Consultative Council) said that if the other Area Boards (excluding London, which had all six of its farms connected) had made since vesting day the same progress in rural electrification as had been made in the South Western Area, more than 50 per cent of the farms of the country would by now be electrified, instead of 42 per cent. The Act laid it down that electricity supply was to be a national, not a regional, service, and the wealthier Boards, with less responsibility for rural areas, should support the less wealthy Boards who were trying to carry out their duty under Section 1 of the Act, to bring electricity as far as practicable to everyone in the country. Since the war 10,000 farm workers had left the land every year. It was not the farmer alone who needed electricity, but the whole of the rural population.

It was disturbing to realise that after six years of connecting farms at the rate of 1000 a year Mr. Steward had reached a position where only one-third of his job was done, and he was forced to admit, at least in private, that he might not be able to proceed much further. Other Boards with large rural areas would before long find themselves in the same impasse. The solution seemed to be to interpret Section 36 of the Act more liberally; this was a national matter. The Central Authority might well make the 33kV lines a national charge on the whole industry and something should be done about the bulk supply tariff to help the rural Boards. If ultimately some form of subvention must be faced, the time to begin thinking about it was now.

Mr. Thomas Johnston (North of Scotland Hydro-Electric Board), said that in the area for which he was responsible there were hundreds of thousands of acres of grazing land, at present hardly used, which could raise enormous herds if winter feeding could be provided. They had been trying for the last four years to produce an electric hay drier or grass-drying machine to improve the yield and the protein value of the hay which was cut and they had had encouraging success; three of the four farmers who took part in their experiments last year had bought the plant. This year they were going to seven other farms and trying to get a group of crofters to send their hay to a common drier. The increase in productivity was astonishing; one farmer testified that for a capital expenditure of £500 he had saved £883 in one year on concentrates and by the increased value of his sheep, while another said that electricity had been the equivalent of two extra hands on his farm. The losses with the traditional method of drying hay amounted to 40 per cent, and with electric drying had been halved, while the protein losses, which were anything from a fifth to a half, had been reduced to almost nothing. It should not be difficult to induce farmers who had already an electricity supply to use more electrical appliances, so increasing their productivity and improving the amenities of rural areas.

Mr. J. S. Pickles (S.W. Scotland Electricity Board) maintained that there had never been a time in the history of the electrical industry when more active and excellent rural development was being carried out or when more was being done to help the "lame ducks." For example, 70 per cent of the working costs were due to the bulk supply tariff, and every Area Board paid the same tariff, so that some Boards paid more than they would otherwise have done in order to help the others. He had been concerned with rural development for nearly twenty years and had lived in perpetual fear of a deficiency, but it had never occurred. In eight years from the vesting date the supply industry would have connected as many farms as had been connected during the previous forty-eight years. He thought that much of this development should be done on the single-phase system. Much construction was still being done three-phase, which in his opinion involved too great an expense.

He did not think that prosperous industries like electricity and agriculture could ask for a subsidy, and a subsidy meant "strings" and a weakening of the feeling of responsibility for the Areas. The Areas had been wisely chosen to comprise urban, industrial and rural areas and each should be able to carry its rural development without undue imposition on urban consumers.

Mr. A. W. Ferguson (Northern Ireland Board) said that in Northern Ireland, after initial losses, they were beginning to make rural electrification pay. He thought it could be made to pay, but the Government must not ask for it to be carried out "in five minutes."

Mr. J. A. Duncan (Merseyside and N. Wales Electricity Board), speaking primarily as a member of the National Farmers' Union, said that in his area farmers were not content with the present position, but were not dissatisfied either, because they realised that a great deal had been done. The problem in this country was to raise a high standard of food production to a very high one, because we already had the most intensive agricultural production of any country in the world. One reason for the low consumption of electricity on farms was that for high farming long-term confidence was required; "in a slump," he said, "high farmers go out like a light." To increase the use of electricity far greater security must be given to the farmer. The Australians had been given a fixed price for meat for fifteen years, and something of that kind could be done here. The commercial side of the electricity industry must carry out more propaganda, and Dame Caroline's organisation could help here through the women's institutes. The manufacturers of electrical goods should make a greater effort to reach the farmers. The farm use of electricity was at present in the "gadget" stage. Farming to-day depended almost entirely on the use of imported oil, a very vulnerable supply in time of war. If it were possible to substitute electric for oil tractors, charging them up at night, it would provide a magnificent load for the supply industry.

Mr. F. W. Godden (E. Midlands Electricity Board) commended Mr. Steward's line rental scheme as a new approach to the problem of obtaining a minimum continuing revenue and as being likely to be more easily understood and accepted than the system of a minimum revenue guarantee over a period of years. It might well, he thought, be considered for national adoption. The modern farm tractor was an exceedingly versatile machine and it was unfortunate from the point of view of the supply industry that it used petrol and not electricity. The possibilities of an electric tractor should be investigated.

Because of lack of time the authors undertook to reply to the discussion in writing.

Progress in Rural Electrification

At a British Electricity Authority conference at Torquay last week, Lord Citrine, chairman of the Authority, stated that because of the importance of rural electrification to the national well-being it was probable that consultation with the Government would be necessary. There was little doubt, he said, that the demand for the widespread extension of electricity to the rural areas would become more and more insistent and that more capital would have to be made available to meet the demand. It was apparent that, apart from capital restrictions, the pace of rural development must be influenced greatly by financial considerations. Whilst the overall consumption of electricity by farms and rural consumers generally had shown a substantial increase, much more extended use could be made of electricity in the countryside. The problem was how rural electrification could be widely extended without involving the Boards in serious financial losses.

129,500 Farms Connected

Lord Citrine drew attention to the number of farms connected. He said that it was gratifying to note that the expansion of rural electrification, although handicapped in the past by capital restrictions and economic considerations, had resulted in some 46,000 additional farms being connected in the last five years. Of these, some 10,163 were connected during the year 1952–53, bringing the total number of farms connected at March 31, 1953, to 129,500.

It was not possible to say with accuracy what was the number electrified at the "vesting date," April 1, 1948. The Authority's own figures showed that at June 30, 1948, the number of farms connected was 80,849. Taking the total of farms at that date as, roundly, 300,000, the number electrified represented roughly 27 per cent. At March 31st last this percentage had risen to about 43 per cent.

Whilst there was no reason to be complacent about this, it was evident that steady progress has been made and that a considerably greater number of farms were now being connected annually than was the case before the "vesting date." Lord Citrine said that the consumption of electricity by farms had increased by about 170 per cent as compared with the year immediately preceding the "vesting date," and in 1952–53 consumption by farms had increased by 17 per cent as compared with the previous year—the highest increase in any of the six categories into which consumers are classified.

Moulding Equipment at the Plastics Exhibition

The second British Plastics Exhibition and Convention which ended yesterday has been held at the National Hall, Olympia, London, where it was opened to the public on June 8th, as reported in our last issue. A considerable area of the exhibition was devoted to equipment used in the plastics industry, much of which was demonstrated in operation. Several machines were being shown for the first time and it was possible to note some significant developments, particularly in the technique of injection moulding machines.

THE introduction at the recent plastics exhibition in London of preplasticising units integral with the moulding machine represents an important advance in injection moulding technique in this country. Two of the machines shown are claimed to be in advance of American designs, where the technique had already found favour.

The plant shown by R. H. Windsor, Ltd., Chessington, Surrey, is known as the "S.H.8/10" single-stage, multi-screw preplasticiser unit and the machine is automatically "cycled." The function of the preplasticiser is to prepare a fully plasticised and homogeneous material to the injection barrel. In this way the characteristics of the material approach more nearly those of a fluid and the pressure gradients and cycle times involved are much reduced. The 8–10oz injection moulding machine on which the preplasticising unit was demonstrated was consequently able to produce articles which, according to the material, weigh up to 32oz, and its maximum plasticising capacity has been raised from about 60 lb up to 140 lb an hour, the swept volume having a capacity of 44 cubic inches.

Another advantage cited for the process is the greater homogeneity achieved in the material before shooting and because of this factor it has been shown from photo-elastic investigations that the material is relieved of much of the internal stresses induced with normal injection moulding. The compounding action during preplasticising also greatly improves the dry colouring disperson.

The complete cycle of operation commences at the vertical material cylinder which contains a plunger incorporating two specially designed screws, which is housed in a heated barrel. A hydraulic motor transmits power, via a gearbox, to the screws; the whole assembly, which is connected to a hydraulic cylinder, moves freely within its stool.

After injection has taken place the material is once more fed into the rear of the screws, which then rotate, pressing the material forward, heating and plasticising it as they do so. There are three heating zones each controlled automatically by pyrometers. At the end of the screw drive it is fully plasticised and is delivered to the front of the barrel under high pressure.

The pressure exerted at the front portion of the barrel forces back the screws, gear drive and hydraulic piston against a predetermined pressure. The return movement can be arrested at any point of the stroke and as this movement is relevant to the weight of shot required it can, if necessary, be actuated to serve the same conditions as the "weigh-in" methods.

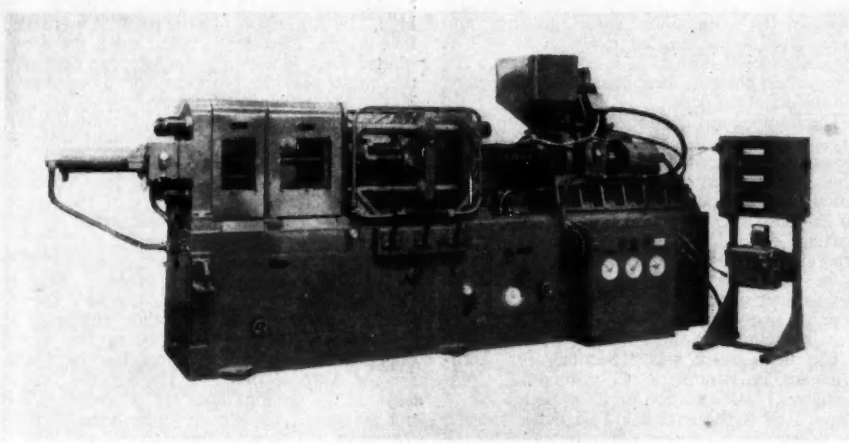
This stage of the complete moulding operation ends within the cooling period. The machine is closed and the plasticised material shot into the mould by the hydraulic cylinder—the screws and drive assembly moving forward with the action.

During the injection phase the screws are stationary and once injection and moulding has occurred the complete cycle repeats.

The other preplasticising machine was exhibited by the Projectile and Engineering Company, Ltd., Battersea, London. This machine is basically an 8oz machine, but with the preplasticising facility its capacity is raised to 16oz.

Another significant detail concerning the injection moulding machines exhibited this year was the adoption of fully automatic cycling on machines of up to 4–5oz capacity. It is envisaged that in this way one man could attend a battery of as many as thirty machines. Incorporated in the machines are micro-switches, with which it was demonstrated that even the inclusion of a piece of paper between the faces of the dies was of sufficient order to stop the machine, the attention of the operator being summoned by such agents as a bell. The longer cycle times involved with shots of over 5oz are such as to deny much advantage to automatic cycling of machines above this capacity.

One automatic machine introduced by the Projectile and Engineering Company, Ltd., Battersea, London, can be supplied with either 4oz or 5oz capacity with displacement volumes of 7 and 8·75 cubic inches respectively. It incorporates the company's latest plasticising chamber, which, it is claimed, enables a much lower pressure drop across the chamber to be obtained, thereby retaining higher pressures at the nozzle.

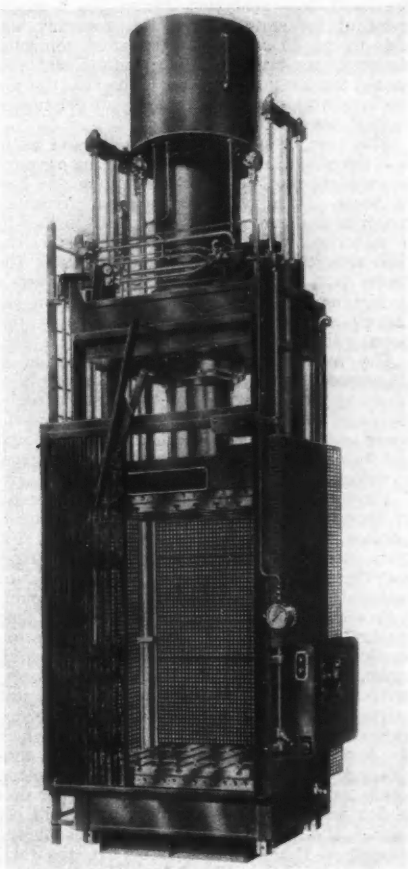


32-Ounce Preplasticising Machine

On the 4oz machine with a plasticising capacity of 40 lb per hour, the maximum pressure on the material is 20,980 lb per square inch, which is sufficient to inject a 4oz shot in the harder materials such as methyl methacrylate.

The plasticising unit is heated by a series of band heaters, which are controlled in two zones by two independent P.A.M. temperature control units to ensure the most satisfactory heating gradient for the material. An indicating pyrometer is provided on the control panel and the temperature of each zone may be measured independently with the use of a toggle switch. These heaters have a maximum power consumption of 6kW.

Adjustment of the injection unit to the sprue bush is entirely automatic and is performed by two hydraulic cylinders. The length of the sprue-breaking movement can be very easily set by the adjustment of a limit switch striker. If sprue-break is not required, the nozzle can be kept in contact with the sprue bush. By the depression of a push button the whole of the injection unit may be withdrawn, allowing easy access to the sprue bush and for scavenging the heating chamber.



100-Ton Moulding Press

The moving platen is normally closed under high pressure, the locking load being 150 tons. Should it meet contact resistance due to foreign matter between the die faces the high pressure fails to build up, the die is reversed and then remains in the fully opened condition until attended.

When the mould is fully closed a limit switch is depressed which selects the injection ram forward, the injection boost and cure periods being controlled by process timers. The injection timer controls the "holding-on" period of the injection ram; the boost timer controls the period of maximum oil delivery and the cure timer governs the period between the initial retraction of the injection ram and the opening of the die.

A further process timer is incorporated in order to provide a dwell before the machine commences another cycle. This dwell timer

ensures that the moulding falls clear before the platen returns to the closed position. The minimum cycle time is 11·5 seconds.

A system for pre-advancement of the injection plunger during the cure period has also been incorporated. This device provides a considerable saving in cycle time, especially under fully automatic control. After the injection timer has finished its run the injection ram moves fully back and then advances to a predetermined position. Thus, that part of the stroke which is not used for actual injection is carried out during the cure period. Should the cure timer be set for a period less than is required for this additional movement, the mould will not open until it is complete.

One of the problems in a plasticising chamber is to control the temperature gradients imposed on the normal heating cycle by the frictional heat generated during the displacement of the material, and this company was able to exhibit a mould temperature controller designed to preheat and maintain accurate mould temperatures. Water is the heat transfer medium working in a closed system pressurised to 25 lb per square inch.

This unit is designed to cool as well as to heat the mould, an efficient cooler being provided in parallel with the heat exchanger, and the flow of water is diverted through either cooler or heater as required ; this process is performed by a motorised valve, which is actuated by the thermostatic setting of the equipment. The cooler is a heat exchanger, to be fed with a continuous supply of cooling water from the factory supply. No loss or drainage at this point is therefore necessary.

The mould-heating or cooling medium is connected directly to the mains ; the supply of water to the required quantity is controlled by means of a ball-cock in the header tank, and the water used is non-consumable, the only amount lost being what is in the mould and external pipework when the unit is disconnected.

The automatic machine shown on the stand of Dowding and Doll, Ltd., Greycoat Street, London, S.W.1, can operate at the rate of 1200 cycles per hour. It is claimed by the makers that there is an advantage by using a machine designed to work at this rate having moulds with a single or a few impressions rather than employ a larger machine with multi-impression moulds working at much lower production cycles. The rapid die opening and closing involved is carried out by hydraulically operated toggle linkage. The plasticising cylinder carries three external band heaters of 750W each which are controlled by " Sunvic " regulators in conjunction with thermostatic dial thermometers. Using acetate it has a maximum weight per shot of 2oz and a plasticising capacity of 22 lb per hour. The pressure on the material at the plunger is 9100 lb per square inch, the total plunger load being 18,850 lb. The die plates measure 10in by 16in and the plunger and platens are water cooled.

Alfred Herbert, Ltd., Coventry, was showing an Edgwick " H7 " injection machine converted to fully hydraulic and automatic operation. The micro-switches on this machine are arranged to stop the machine in a partially closed condition should any foreign matter prevent complete contact between the die faces. It has a moulding capacity of 1½oz and can operate at 6 cycles per minute. The maximum pressure to which the material can be subjected is 16,000 lb per square inch and the closing pressure is 30 tons. The maximum mould size is 12¼in by 11in.

The machine is equipped with a heating cylinder which has a plasticising capacity of 10 lb of cellulose acetate material per hour. This cylinder is fitted with a torpedo arranged to give rapid and uniform heating and it can be easily dismantled for cleaning. Heating is by means of a 1·5kW external heating band, operated at 220/240V, single phase. A nozzle heater is also provided for use when starting up ; this can be cut out when not required. The heat control is by means of a " Sunvic " impulse energy control in series with a Cambridge thermostat, giving a range of temperature controls between 100 deg. and 520 deg. Fah. Special cylinders can be supplied as extras for use with P.V.C. material and also nylon.

The dimensional characteristics and the low-pressure processing technique of moulded fibre reinforced plastic articles have necessitated the development of presses having a characteristically larger platen area and greater daylight area between the platens. Amongst the plant at the exhibition designed for this purpose is the 100-ton press illustrated on page 867 and made by T. H. and J. Daniels, Ltd., Stroud. It is a downstroke prefilling press having fabricated steel tables and head, the moving table being guided between the columns. The tables are 4ft by 3ft and the stroke 4ft. The maximum daylight available being 7ft. It is necessary with platens of this size to restrict the temperature rise of the platens and both the fixed and moving tables are drilled for cooling water. As it is more convenient with the sizes of moulds involved to provide heating ways on the moulds themselves no integral provision is included in the press for this purpose.

The press is a self-contained unit having a vane pump driven by a 12·5 h.p. motor, which is mounted on the press head along with most of the other piping and valves. The maximum moulding pressure of 100 tons is obtained with a working pressure of 1000 lb per square inch. A hydraulic arrangement permits fast closing speeds with a gradual closing of the mould at any predetermined part of the stroke. The top speed for both closing and opening is 5in per second. The slowing valve can be by-passed during the opening stroke if required, after a period of five seconds has elapsed. The machine is fully and automatically guarded. Similar presses of 150 tons and 250 tons are also available.

Annual Meeting of the Association Technique Maritime et Aeronautique

THE fifty-second meeting of the Association Technique Maritime et Aeronautique was held at 2, Place de la Bourse, Paris, and after the general meeting, which opened on Monday afternoon, June 1st, at which annual reports were read, a statement of accounts given and directors appointed for 1953, two papers were read. The first paper presented was " A Critical Survey of Sea Trials," by R. Brard and M. Jourdain. Having examined the systematic and casual errors made during trials at sea, the authors recalled to mind the contractual method of exploiting the results of these trials and criticised it. They set forth a new method based on the propulsion laws of vessels and their conclusion was, that if the measures were carried out with all the precision made possible by existing devices and the trials organised in such a way as to allow a maximum of useful lessons, the results obtained must permit of completely determining the performance, not only during acceptance trials, but also under normal service conditions. The second paper was " A Comparative Study of Cargo Boats," by G. Deparis. The author stated that the costs of cargo boats are generally expressed " per ton of deadweight " despite the fact that for one and the same deadweight capacity the dimensions, speed, tonnage and capacity of holds may be different, as well as the daily fuel consumption at equal speed. The comparison between these characteristics formed the subject of the paper.

The meeting was continued at 9 a.m. on Tuesday, June 2nd, with a paper entitled " Statistical Research on Servo-Systems," by M. Pelegrin. This paper directly determined the transfer functions of compensating lines of servo-systems, on the basis of statistical considerations on the starting signal. Formal calculations in the general case (Wiener-Lee theory) were stated to be very slow, but in the particular case of servo-systems, formal and numerical calculations were extremely easy and non-linear relay systems may be included in the chain.

The next paper was " Sections for Aerodynamics in Parametric Co-ordinates. Comformable Transformation of these Sections in a Circle," by S. Boudigues. This paper showed the possibility of writing down very rapidly the parametric equations of a section of given geometrical characteristics (camber, thickness, radius of curvature, angle of attack and trailing angle) ; analytically expressing the values of the section and of the elements of the inertia central ellipse ; coming near, with great precision, to any section by means of an analytical formula, and operating a conformable transformation of these sections into a circle, which leads to the analytical expression of the speed at any point. The third paper presented was " Approximate Calculation Method Regarding Efficiency of Aeroplane Cabin Sound-Proofing," by M. Kobrynski. The author stated that after examining the phonic insulation of an enclosed space surrounded by a homogeneous and isotropic sound field, the additional acoustic insulation which results from coating the walls of the enclosed space with a material of any kind can be determined. The validity of the relationship has been investigated in the case of an aeroplane cabin while taking into account the heterogeneity of the acoustic radiation on the fuselage. The paper showed that this resulted in a propagation of sound energy by way of air and structure from the zone of maximum density of spectral energy in the cabin. A correcting factor was suggested to make allowance for this fact. A general calculation method was set forth for additive reduction of sound levels in aeroplane cabins resulting from sound-proofing, the calculation elements being the transmission coefficient and the reflection absorbing coefficient of selected double walls. The precision of this calculation method was shown by a practical example. The fourth paper was " Stability Criterions," by L. Frager. The author gave a general outline of stability criterions existing in linear systems and showed how the Routh and Nyquist criterions rest on a single general principle. Several novel demonstrations were given.

During the afternoon session six papers were presented and the first of these was " The Influence of the Erroneous Valuation of the Speed of Advance of a Propeller Behind a Given Hull," by J. Guérist. In the paper it was stated that graphic calculation, when using the curves plotted for a family of propellers, can determine the most suitable propeller for a considered hull and to make use of these curves the strength of the hull has to be taken into consideration. The faulty valuation of pitch speed modified the optimum propeller characteristics and brought about a variation of the designed speed by altering the tuning up point of the engine. The paper analysed the consequences of this mistake for two very different hulls.

The next paper was " The Influence, on Propeller Pitch, of Staggering the Trailing Edge of the Blade Sections," by M. Costales Gomez Olea. In this paper the author attempted to determine the corrections to be applied to the pitch of a Troost type propeller in which, for the purpose of easier casting, the trailing edge of the sections near the propeller hub is not staggered, these corrections being such as to permit of retaining, for planning and designing purposes, the diagrams initially set up by Professor Troost.

The third paper to be given was " Simplified Method for Preliminary Determination of Power of Propelling Machinery in Single-Screw Vessels," by J.-A. Van Aken. The author developed a method which makes it possible to determine the propelling machinery power of single-screw cargo vessels and liners designed for deep sea or coastal traffic. A detailed example dealing with a single-screw merchant vessel compared the results obtained by this calculation method with those drawn from a method published previously by the author.

The next paper was entitled " Comparison Between the Results of Sea Trials and Model Results of the Liners ' Flandre ' and ' Antilles,' "

by R. Brard and M. Jourdain. In this paper the authors drew a parallel between results obtained from trials at sea of the liners "Flandre" and "Antilles," and predictions formulated after model investigations of these vessels at the Paris Experimental Tank. The method used, which was explained in a previous paper, enabled the influence exercised on the vessel's performances by the time elapsed since the last careening to be estimated. The fifth paper presented was "Sea Trials and Model Tests of the Liners 'Provence' and 'Bretagne,'" by R. Brard.

This paper drew a parallel between results obtained at sea and in the experimental tank of two vessels differing from one another only in their appendages, propellers and propeller shaft brackets. The powers required to obtain a given speed differ, for the two vessels were stated to be in the same proportion as for the two models.

The last paper given on Tuesday afternoon was "Sea Trials of the Passenger Cargo Liner 'Ferdinand de Lesseps,'" by R. Brard, M. Jourdain and D. de Mas Latrie.

The meeting opened on the morning of Wednesday, June 3rd, with the reading of a paper entitled "Results Obtained by Checking Welds by Gamma Rays," by G. Forest, and this was followed by "The Development of X-ray Photography Techniques in Shipbuilding," by G. Brachet. The next paper given was "Some Observations on Bolted Joints Under Cyclic Loading," by H. de Leiris.

The paper discussed the lines along which the cyclic tensile tests on bolted assemblies have to be organised in order to predict the service behaviour of such assemblies and described the testing method adopted. This technique was illustrated by means of several examples of investigations concerning the design of nuts, the thread section related to the metal used, the method of forming the thread, and the advantages of cold rolling as well as the clearance between bolt and nut. The fourth paper of the session was "Experimental Contribution to the Problem of Pipe Flanges," by M. Ballet. The paper dealt with two forms of flanges for high-pressure steam pipes and gave the results, made possible by modern measuring techniques, of distortions as a whole and of stresses on outside and inside surfaces.

The meeting was continued in the afternoon of Wednesday with the reading of five papers, of which the first was "Comparison Between the Use of Direct and Alternating Current on the Passenger-Cargo Liners of the 'Ferdinand de Lesseps' Group," by C. Lacoste. The author mentioned that the completion of the "Ferdinand de Lesseps" permitted the advantages obtained by using alternating current on board ships of this design to be determined, and it appeared that for this class of vessel there was a slight reduction in weight and of price in favour of alternating current. Extrapolation of the results established the point where the choice of either kind of current is equally satisfactory, while alternating current was indicated for fast liners and tankers, and direct current for cargo-boats. The second paper presented was "The Thermodynamics of Internal Combustion Engines," by A. Pommelet. The paper recalled that the generally accepted thermodynamic theories of the internal combustion engine dealt only with the working of a cyclic engine using a perfect gas energy transforming fluid, while the basic problems of combustion and heat exchange were neglected. The Sulzer Company has worked out a diagram which approached much nearer to the facts, and the author, by means of simplifying assumptions, examined the question.

The next paper was "Static and Dynamic Calibration of Torsiometers," by P. Villepelet and M. Jourdain. The authors have made a detailed study of errors occurring during shop calibration of shafts carrying a torsiometer. They noted the gradual perfecting of a high precision calibrating bench, the statistically obtained results, the comparison of torques measured during tests of a diesel engine by means of a Froude brake and a shaft-torsiometer unit, and drew the conclusion that credit may be given to torsiometric measures if the torsiometer is correctly mounted and calibrated on a precision bench. The fourth paper read was "Testing an Acceleration Gate in a Compressible Fluid," by W. Luksch and A. W. Quick. This paper gave the test results obtained on plane gates, the sections of which were chosen among those used in turbine guide vanes. For a given section, tests were carried out with different shapes of the trailing edge and five different pitch ratios, in order to determine the influence upon the losses of the Mach number at the outlet and the results showed that the losses depend to a large extent on the Mach number of the flow at the outlet for different thicknesses and different shapes of the trailing edge. The pitch ratio, however, greatly influenced the variation of losses in terms of Mach number.

Measurement of pressure distribution and stroboscopic photography indicated the origin of the losses and explained the behaviour of the acceleration gate at different Mach numbers.

The last paper read during the afternoon was "Some Research Work on Turbo-Engines," by E. Maillet. Several examples of experimental studies on parts of axial superchargers and on centrifugal superchargers were presented by the author and the results assisted in specifying the most suitable testing methods and techniques, as well as the selection of measuring equipment.

On Thursday morning, June 4th, five papers were read and the first to be presented was "Installations Conducive to the Improvement of Handling Operations on Board Ship and of Operating Merchant Ships," by P. Bain. Present-day handling conditions on board ship were investigated by the author, who gave solutions which appear to be generalised in the future. The paper reviewed the effect of using steel watertight hatches on exposed decks, flush steel watertight hatches on the main deck under the shelter deck, of removable bridges and of "Bipod" masts, on handling conditions on board ship, and operating conditions of merchant vessels. The next paper was "Standardisation of Shipbuilding Plates," by P. Legrand. The standardisation of plates for shipbuilding was considered by the author on the basis of the adoption of a standard length and breadth and the reduction in the number of standard thicknesses. The paper justified certain margins on regulation thicknesses, without increasing the overall weight, and yet continuing to maintain the same standard of strength. This paper was followed by "Contribution to the Research Work on the Coefficient of Losses Due to the Sides of the Vessel," by E. Merlin. The author defined the "coefficient of losses due to the sides" of a vessel and gave the results of measures carried out on several fruit freighters. He outlined the method of calculating this coefficient. Taking the results obtained by this method as a basis, he analysed the disturbances caused to the insulation by the structure of the vessel, and emphasised the importance of correctly applying the insulating material, while the measures to be taken in order to ensure faultless insulation were mentioned.

The fourth paper presented was "Stress Distribution in Corrugated Steam Pipes," by H. de Leiris. It was recalled by the author that an earlier paper examined the flexibility of corrugated straight or bent tubes, but owing to the lack of equipment the problem of stresses in the tube wall could be tackled only indirectly by measuring the flexibility limit as a whole. This problem has now been investigated with the help of the 2mm base pneumatic tensiometer, and it was stated that in straight tubes, which take a revolving load, the major stresses depend exclusively on the expansion sustained by the tube. Bending complicates the phenomena and may create notable irregularities from one corrugation to the other.

The fifth paper read during the morning was "Experimental Testing of Flexibility Isotropy of Warped Tubes," by M. Ballet.

The concluding session of the meeting was held on Thursday afternoon, when a further five papers were given, beginning with "Tendency of Vessels to Turn Due to Propeller Effect," by P. Dussadier. In the paper it was stated that single-screw vessels show a tendency to turn to the opposite direction of the propeller rotation, and the author suggested an explanation in place of that generally accepted, which he believes is erroneous. In the paper he stated that the water does not enter the propeller in a direction parallel to its axis, but with an upward motion, due to the shape of the hull. Therefore the pressure exerted by the blade on the downward movement is greater than on the upward, thus producing a thrust which is off centre. The next paper was "Comments on the Hull Bending Tests," by L. Fea. In the paper the author presented a comparison between results obtained during bending tests carried to breaking point on American and British destroyers, and discussed the benefit of such tests as well as the lessons which may be drawn therefrom. The third paper given was "A Study of Brittle Fracture with Reference to the Damage Sustained by the 'Grenoble,'" by A. Audige, followed by a fourth paper entitled "On the Weakness of Ship Decks at Openings and the Strengthening to be Provided," by H. de Leiris and H. Dutilleul. In this paper the authors discussed the damage to strength decks starting at the corner of a deck opening and originating from the concentration of stresses at this point due to the longitudinal bending stress of the vessel. They investigated the optimum shape to be given to the outline of an opening in order to reduce these stresses. This analysis was made by tensiometric measures based upon the assumption of a wholly welded deck which included no stiffeners near the openings. The final paper read at the meeting was "Towing in a Heavy Sea," by G. Deparis. In this paper the author considered the movements of a vessel towed in a heavy sea and the strains imposed upon steel wire hawsers, and suggested the use of chain cable for this purpose.

Tour of Seine and Loire Shipyards

The annual dinner of the Association Technique Maritime et Aeronautique was held on Thursday, June 4th, at the Hotel Lutetia, Paris, and presided over by Général d'Armée Aerienne, Martial Valin, Inspector Général de l'armée de l'air. There were present about 170 members and their guests, including several representatives of the British technical journals who had been invited to visit Paris by the Association. The Association and the Chambre Syndicale de Constructeurs de Navires et de Machines Marines had also arranged for the British technical journalists to see something of the progress made by French shipbuilding and for that purpose had planned a tour of shipyards in north-west France.

Before starting the tour the party was entertained to a luncheon given by Monsieur René Fould, the president of the Chambre Syndicale, at the Cercle Interallie, Rue du Faubourg Saint-Honoré, on Thursday, June 4th, and later was able to visit the Musée de la Marine. This museum, which is housed in the Palais de Chaillot, contains a large and varied collection of models of ships covering many centuries of shipbuilding and illustrating the gradual evolution of the ship, from the early galley to the present-day liner. A series of marine paintings serves to illustrate the costumes of the times and the early layout of the ports. An extensive reference library forms part of the museum and an interesting development is the section which prepares plans for model makers to make reproductions of the many vessels of historical interest which are housed in the Palais de Chaillot.

On Friday morning, June 5th, the party left Paris by road to visit the Ateliers et Chantiers de Normandie, on the Seine near Rouen, which was founded in 1896. It was interesting to note that this yard had adopted the projection system of marking off and also had adopted a special form of stern frame and rudder. The next yard to be visited was the Ateliers et Chantiers de la Seine Maritime at Le Trait, which was started in 1916 and built its first ship in 1920. The yard was heavily damaged by bombing during the second world war. By 1949 the yard, which has eight berths, was reorganised and now is laid out largely for welded construction, the ships building being up to 80 per cent welded. A development originated by Bureau Veritas was noted in the construction of the oil tankers on the stocks, involving the adoption of a steel bar of about 4in diameter and several feet in length, which had chamfered ends and bent into a bow shape to form the connection between longitudinals to which it was welded. The yard, which was built right in the country, has developed its own community, the company building houses for its workpeople who now number about 1300.

On Saturday morning the party arrived at

the Chantiers et Ateliers Augustin-Normand, founded in 1728 at Honfleur and transferred to Le Havre in 1816. In common with so many shipyards, it suffered heavy war damage and is now building a number of minesweepers, of composite construction, and other small craft. Of considerable interest in the yard was the gas turbines fed by free piston gas generators which the company are building, under licence, in its engine shops in association with the Société Industrielle Générale de Mécanique Appliquée. One of the Pescara free piston compressors driving a gas turbine was seen on the test bed. Later in the morning the Forges et Chantiers de la Mediterranée was visited and a tour made of the workshops where Sulzer diesel engines are under construction. The company cuts its own gears on the Maag system, and besides building an occasional steam engine is manufacturing variable-pitch propellers to its own design.

From the Seine the party journeyed south towards the Loire by way of Caen, Avranches, Pontorson, Cancale, Rennes and La Baule, and were able to pay a visit to the famous Mont Saint Michel and to see something of St. Malo, including a tour of the walls of the old town. On Monday morning the tour was continued at the St. Nazaire yard of the Ateliers et Chantiers de la Loire, where an unusual layout is employed for the building and completion of ships. This takes the form of a dry dock linked with a building platform, the whole being enclosed, with the dock gate giving the only exit to the river. The building platform has five lines of piled supports and can accommodate four medium-size ships, which are launched by flooding the platform and are then pulled across the basin to the dry dock for completion. Between the platform and the dry dock is a prefabrication area and the ships during all stages of construction can be served by a large travelling crane with a maximum lift of 240 tons. This crane has recently been used to lift completely prefabricated superstructures on to the ships.

The neighbouring shipyard of the Chantiers et Ateliers de Saint Nazaire Penhoët, where the "Normandie" was built, was visited next to see something of the ships building on the slips and the work going forward in the engine shops. A number of oil tankers were in an advanced stage of construction and speed of building was especially noted. One ship of 26,000 tons deadweight was expected to be on the stocks for only six months. Another item of interest was the provision of a five-bladed propeller for a 31,000-ton deadweight tanker. This yard is equipped with special arrangements for the forced drying of timber. The engine shops, which are mainly engaged in the building of Burmeister and Wain and M.A.N. diesel engines and Parsons turbines, are well laid out for the prefabrication of bedplates, gearcases, and other equipment.

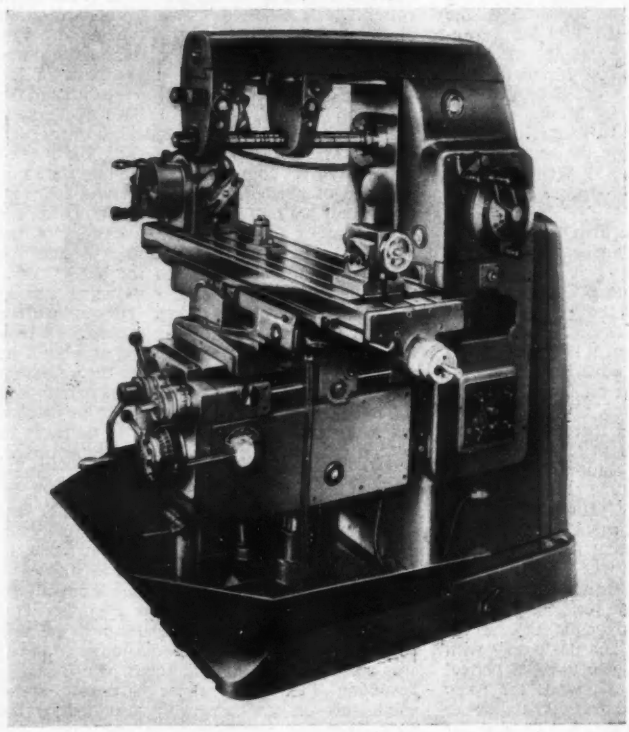
From the mouth of the Loire the party went inland to Nantes, where the first visit was paid to the Ateliers et Chantiers de Bretagne, which is one of the biggest builders of marine engines in France. Rateau designed turbines are built in the extensive and well equipped engine shops and the company has some gas turbines under construction and also has developed a variable pitch propeller to deliver 3000 h.p. The shipyard, which has three berths, is building "escorteurs," of a size similar to the British "Daring" class, for the French Navy. This yard makes a practice of buying ship plates in standard sizes. The Nantes yard of the Ateliers et Chantiers de la Loire, where destroyers of about 1500 tons are under construction, one of which was fitting out afloat, was visited next. Of the four berths available it is understood that at present only two are used, and in the engine shops Sulzer diesel engines were under construction. The final visit of the tour was paid to the works of the old-established firm of Brissonneau et Lotz, which manufactures a large variety of products for both marine and land purposes. Equipment supplied for ships includes deck machinery such as electrical winches, capstans and windlasses, steering gear, davits, including those of "Schat" design, refrigeration installations, and diesel-driven generators. Other items noted during the brief tour was the production of evaporators, heat exchangers, welding positioners and a considerable amount of prefabrication in aluminium alloy.

During the return journey to Paris two famous chateaux were visited at Chenonceaux and at Blois, and a brief outside view was taken of the Cathedral at Chartres.

The tour of the Seine and Loire shipyards and engine works revealed the tremendous effort which the French shipbuilders have put forth to rehabilitate and modernise the various plants so extensively damaged during the war. In many instances this has meant almost complete rebuilding, so that the present condition of the yards has only been achieved at considerable cost and represents a large capital investment. This incurs a heavy charge upon the industry and to meet commitments the importance is realised of the yards receiving a sufficiency of orders to maintain a reasonable degree of employment of the plant, such orders being integrated with the economy of the French mercantile marine.

Improved Milling Machines

THREE models have been added to the range of "Victoria" horizontal milling machines made by B. Elliott and Co., Ltd., Willesden, London, N.W.10. These machines, which incorporate a number of improvements and have automatic and rapid traverses in all three directions, have the same dimensional characteristics. One, the "U 2 R," is a universal machine; the second, the "P 2 R," is an automatic cycle plain milling machine with single lever control, whilst the third, the "P 2 RA," is similar with fully automatic control through push buttons, which replace the lever of the "P 2 R."



Universal Horizontal Milling Machine

In these machines, one of which can be seen in the accompanying illustration, separate motors are fitted to the spindle and feed drives, both being controlled through the same lever. The motors are interconnected so that the spindle motor can be braked and stopped when rapid traverses are operated.

The table, with a working surface of 50in by 12in, has an automatic longitudinal traverse of 38in, and similar cross and vertical traverses of 10½in and 16½in respectively. The spindle is driven by a 5 h.p. motor though an inverted tooth chain, and a gearbox giving twelve speeds from 25 to 1200 r.p.m. Enclosed within the knee casting is a 1 h.p. stator rotor unit which provides the power for the feeds and rapid traverses. It gives eighteen feeds in all directions, those in the longitudinal direction being from 0·5in to 12in per minute, in the transverse direction from 0·7in to 17in per minute, and in the vertical direction from 0·375in to 9in per minute. A single lever on the operator's left hand controls both motors and this lever, in conjunction with a switch on the column of the machine, provides various combinations of spindle and feed controls. As already pointed out, this lever is replaced by a series of push buttons on the automatic machine to allow it to be used as a production or a tool room machine as required.

A new vertical milling machine being made by the firm has similar speeds, feeds, table sizes and traverses, &c. Its spindle nose is bored No. 50 I.S.T. and the maximum setting distance between the nose and the table is 19in, the distance between the spindle centre to the column being 14in. This machine is available with either single lever or push button control of the motions.

Mechanised Joint Maintenance for Concrete Roads

ABOUT eighteen months ago we recorded in this journal* a description of several machines used by the Road Research Laboratory to demonstrate mechanical methods of cleaning and sealing the joints in concrete roads. Generally speaking, those machines were of American origin, and had been acquired by the laboratory. That demonstration was arranged with the idea of encouraging the manufacture of similar machines in this country, and hence the mechanisation of this tedious maintenance task. We now learn that Expandite, Ltd., Chase Road, London, N.W.10, is making a range of machines suitable for the complete mechanisation of joint sealing and maintenance.

There are four kinds of machines in this range, necessary for the complete mechanisation of joint maintenance. The first is a grooving machine, which cuts out the old sealing compound and roughens the side walls of the joint. There is then a power brush for cleaning out the joint; a cutter may be fitted to this machine in place of the wire brush, for use when sealing the joints in new construction. Some specifications call for the joint filler to be left flush with the surface of the concrete, so that sealing is not carried out until the site traffic has departed. The cutter of this machine may then be used to remove the filler to the depth required for sealing. The third machine of the range is a priming machine which blows a jet of air into the joint to give it a final cleaning, and then sprays on the primer. Lastly, there is the melter-pourer which heats and melts the sealing compound, and is fitted with a pouring shoe for placing the sealing compound in the joint and leaving a flush surface. For work on large areas of concrete, such as a hard standing or a runway of an airport, there is also a large mobile melter, which supplies sufficient molten sealing compound to keep at least two melter-pourers fully at work.

In practice, it has been found that about 1000 yards of joint may be cleaned and sealed, as a maintenance task, in one day with four men

* THE ENGINEER, September 28, 1951.

operating two grooving machines, one power brush machine, one priming machine and three melter-pourers. For new work the two grooving machines may be dispensed with, and replaced by a power brush machine fitted with the cutting tool.

The joint grooving machine is very similar to the American machine illustrated in our previous article. It is self-propelled, being mounted on two wheels with a pilot wheel to control the depth of cut. Cutting is carried out by a "flail" action—there are two circular plates with six cutting wheels mounted between them at the periphery. The cutting wheels rotate freely, and when the whole assembly is rotated at high speed, each cutting wheel is caused to rotate on its first impact with the surface below, and starts to cut that surface on the second impact. The cutter head is rotated at 2000 r.p.m., the six cutting wheels being mounted on hardened steel spindles, and being made of toughened alloy steel. The standard diameter of a cutting wheel is 4½in, normally giving a groove with a maximum depth of 1in, and a width from ¼in to 2in. Cutters of other dimensions may be fitted, however, to give deeper grooves. The cutter head is driven by a standard four-stroke, twin-cylinder J.A.P. engine developing 8 h.p. at 2000 r.p.m. with a V-belt drive. Exhaust from the engine is directed as a jet into the groove to clean it out as the cutting progresses. The chassis of the machine is of welded steel plate, its overall length being 4ft, its width 3ft, and weight 616 lb. We are told that about 1000 yards of joint can be cut before it is necessary to change the cutting wheels.

The power brush machine is of the same design as the one we described previously, consisting of a rotary wire brush mounted on a somewhat similar chassis to that of the grooving machine, and driven by a single-cylinder, 3·5 h.p. petrol engine. The modification since made to the wire brush machine, allowing a cutter to be fitted instead of a brush, was mentioned above. The cutter consists of a hardened steel wheel with eight cutting teeth, the overall diameter being 8in. The wire brush is also of 8in diameter,

Priming Machine

revolving at about 1700 r.p.m. The machine is balanced for easy operation.

The priming machine consists of a three-wheeled chassis carrying a petrol engine to drive a compressor, which supplies compressed air for both the cleaning jet and for spraying the primer. The primer is stored in a small tank as shown in the illustration of the machine on this page. The air jet, the primer spray and the arrangements for controlling them, including the lever for adjusting their height, may be seen in the illustration.

The melter-pourer also illustrated on this page consists of an inner tank of about 15 gallons capacity, in which the sealing compound can be melted for the normal run of small road maintenance jobs, giving a daily output of about 45 gallons. The inner tank is surrounded by an outer tank containing 5 gallons of oil, and pipes carrying oil pass through the melting chamber to give uniform heat transfer, thus avoiding local hot spots. The oil is heated by a pressure type paraffin burner. The pouring spout of this machine is also heated, and there is a valve at the tank outlet to control the flow of compound into it. There is a second valve at the spout outlet, to control the amount of compound flowing into the pouring shoe, a simple lever on the handlebar controlling this valve. A second lever raises the shoe off the ground when

The Melter-Pourer

it is not in use. The shape of the pouring shoe may be observed from the illustration; it is rubber-lined to give a "squeegee" finish. As with the power brush and priming machines, no power is provided for propelling the melter-pourer, but attention has been paid to its mounting and balance to give it maximum mobility. Its weight is 430 lb and its length and width 4ft and 3ft respectively, its construction being of welded sheet steel. The oil temperature in the outer tank is measured by a thermometer, and there are manually operated agitating blades in the inner tank.

The mobile melter for use on larger jobs is generally of similar construction to the melter-pourer with an inner tank for the compound and an outer "jacket" of hot oil, and oil is also circulated in tubes which pass through the inner tank to give more rapid heating. It has a capacity of about 15 cwt (about 160 gallons), and under the most favourable conditions it can supply about 1 ton of melted sealing compound daily. The weight of this machine is 2 tons; it is 10ft long and 7ft wide.

A Bridge at Namur, Belgium

An important bridge is at present being built over the River Meuse at Namur. The new structure, called the "Pont des Ardennes," is a steel plate girder bridge, having an overall length of 620ft. There are three spans, the central one being 450ft long. The decking is 58ft wide and accommodates a 40ft roadway and two cantilevered footpaths. The overall depth of the main girders is 7½ft at the crown and about 20ft at the springings. The structural system of the bridge consists of four main girders, 12mm to 30mm thick, interconnected two by two by means of the lower and upper flanges. The bridge is designed to carry a total live load of 1350 tons. The new bridge will be structurally stiffer than the long-span bridges built recently over the Rhine in Germany. The contract for its construction was let to the Ateliers de Construction de Jambes-Namur. The steel superstructure was erected on the cantilever principle from each river bank. At present work is proceeding satisfactorily. The ceremony of closing the main girders over the River Meuse took place recently.

The Iron and Steel Corporation's Report

On Wednesday last, there was published the annual report which the Iron and Steel Corporation of Great Britain is required to make to the Minister of Supply. The period which it covers, October 1, 1951, to September 30, 1952, is the first full year in which the Corporation has operated. As under the Iron and Steel Act, 1953, the Corporation is to be dissolved, this, its second annual report, must be considered as its last. It will be recalled that, by the Iron and Steel Act, 1949, there was conferred upon the Corporation the rights of a holding company for the iron and steel-producing companies brought under public ownership. The report shows that, in the year under review, the output of these companies, measured by sales of all kinds totalled £733 million, or, if inter-company sales are excluded, the total value of sales was £618 million. The profits of the Corporation group of companies amounted in the year to £64,426,216 after setting aside an extra £10,000,000 for depreciation in addition to the normal depreciation provided for by the companies. In the opinion of the Corporation, the report notes, this additional provision for depreciation is essential to meet the continued rise in the cost of replacement and modernisation of plant, equipment and buildings.

The report points out that manufacturing costs in the iron and steel industry continued to rise during the year, and, in addition, there was a considerable burden placed on the industry in respect of losses over imported steel which was bought at high prices overseas and resold at home prices here. Although selling prices of steel products were increased in February, 1952, to cover part of the losses on imports, they were not sufficient to cover all the increased costs. Consequently, the report says, the profits of the companies diminished in the latter part of 1952 from the rate earned in the first three months of the financial year.

There is also reference made in the report to capital development in the iron and steel industry, which has continued at a high level, note being made of the fact that the general programme of development over the next five years has been largely settled. The capital expenditure on major projects is estimated at £263 million, and the total expenditure on replacement, rebuilding and new construction will probably approach £350 million. The Corporation and the companies have been able to finance the operations of the companies and the heavy capital investment without recourse to new loans or to the issue of more iron and steel stock during the year. But, the report comments, if the Corporation were to continue during the current financial year it would require to borrow at least £25,000,000 for these purposes. The report goes on to say that there will be a heavy call on the liquid resources of the companies, where they exist, to finance the programme of capital development, extended trading, the increased cost of materials and heavier stocks. In the view of the Corporation, therefore, it is most important that the industry should continue to operate at a profit not less favourable than that in the year covered by the report.

Most of the statistical material included in the report has already been published, notably in the annual report and monthly bulletins of the British Iron and Steel Federation. The Corporation's report puts on record figures relating to the production and supply of iron and steel and the availability, consumption and stocks of raw materials. There are also figures showing the number of people employed during the year in the various sections of the iron and steel industry. Other chapters of the report deal with the Corporation's relations with the Minister of Supply, with steel prices and distribution, and with research. In this last chapter, it is stated that the Corporation and the publicly owned companies have continued to give support to a number of industrial research associations, the chief of them being the British Iron and Steel Research Association.

A separate volume, published at the same time as the Corporation's report, contains copies of the annual accounts of all the publicly owned iron and steel companies.

The Preparation of Structural Steel Sections

A fully mechanised plant for the drilling of steel sections has been developed by Boulton and Paul, Ltd., and installed in its Norwich works. In addition to speeding up the work of section preparation, introducing a much closer control of accuracy and making available a large floor space for other work, this plant has enabled considerable reductions to be made in the number of hands hitherto employed on marking-off, template making and handling work between operations.

ALTHOUGH most branches of the engineering industry have increased production during recent years by the development of new machines and methods, little overall mechanisation to increase output and reduce labour requirements has been introduced in the structural steel industry. This lack of mechanisation in such an important industry is perhaps not surprising, for in the preparation of structural steel the nature of the work constantly changes and batches of relatively few parts are called for in varying sections, sizes and lengths. Thus, the accepted practice for producing the component units in a structural steel works has for long been to make templates of each of the members from detail drawings and use these templates to mark off the holes, notches, &c., on sections cut to length. Drilling, notching, &c., is then done on individual machines and the bars or sections sent on to the assembly lines. Between the stock yards, the marking-off and the machining processes, the sections have to be moved by cranes or trucks and much heavy handling is involved.

At first glance this production method would appear to offer little prospect for mechanisation. Despite the apparent difficulties, however, a certain amount of mechanisation to reduce handling time and the number of processes has been carried out to advantage in some structural steel works in this country and abroad. But what is probably the greatest step which has yet been made in this direction is the great reduction in production time made possible with a new plant now in operation at the Norwich works of Boulton and Paul, Ltd. The possibility of improving the methods of structural section preparation was first considered by the firm in 1949, and before starting on the actual design of a plant, its engineers went to the Continent and the United States to see what degree of mechanisation had been attempted and operated successfully elsewhere. After those investigations had been completed, designs of equipment were prepared and the construction of a plant was started in 1950.

With the new plant now installed and the system evolved for its use, template making and the marking-off of sections in the works has been completely eliminated, actual machining time has been reduced substantially and lifting and transport of the sections between operations is no longer necessary. The amount of labour required for section preparation has been considerably reduced whilst output has increased, and much floor space has been saved for other work.

Before describing the plant it should be mentioned that drawings are not now required in the workshop until the assembly stage is reached. A special form or job-chart is prepared from the drawing, on which is given the job number, section and size, length, cutting particulars, hole diameters and setting sequences to be followed on the various machines. Lengths given on the drawings are mechanically added in feet, inches and sixteenths in such a way as to provide an automatic check on many of the draughtsman's calculations. The form for each batch of bars is issued first to the stockyard foreman and from him the form is passed from machine to machine with the bars to which it relates. This has greatly simplified the work of planning the loading of the plant, for once the production programme has been decided it is only necessary to issue the forms to the stockyard in the correct order and the work follows through the plant in the same sequence.

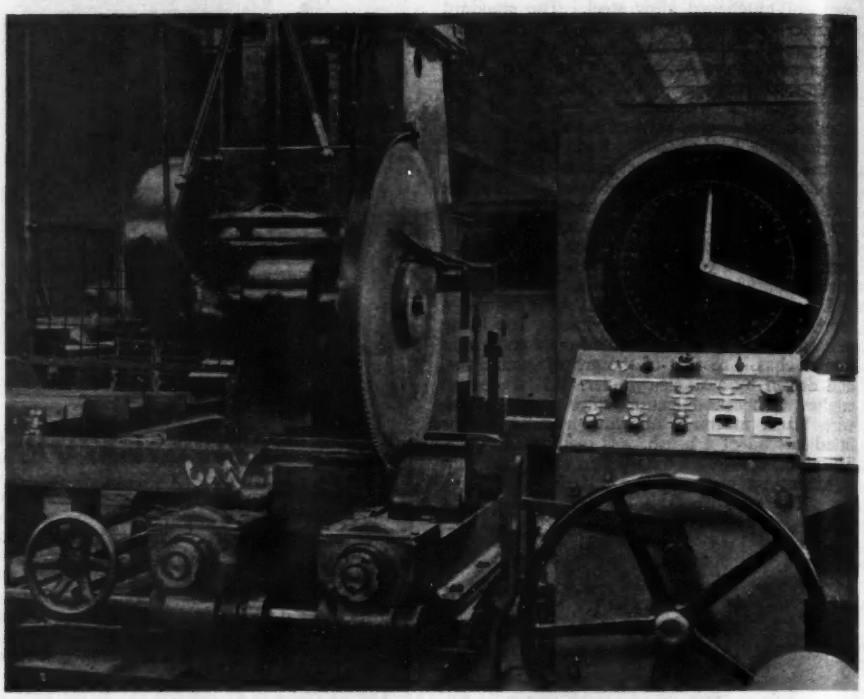


Fig. 2—Vertical Saw and Control Desk

Fig. 1—Drilling Machine for Structural Steel Sections

The plant is designed to handle all structural steel sections up to 27in by 12in by 55ft long, and its general layout can be seen in Fig. 1. It consists essentially of roller conveyors and feed benches between a vertical cold saw—to be seen in the left background of the illustration—a horizontal drilling machine—midway along the plant on the right-hand side—and a vertical drilling machine in the left foreground. The stockyard is on the right-hand side of the plant at the far end of the shop.

In the first operation stock bars are loaded by a crane on to a bench which feeds the cold saw. When the saw operator depresses a button on his control panel the bar is drawn by the dogs of an endless chain across the feed bench to a roller conveyor table leading to the saw. This roller conveyor forming the feed table of the saw has all of its rollers chain driven through reduction gearing by a 3 h.p., two-speed motor, giving two feed rates of 60ft per minute or 3ft per minute. As sections of widely varying widths are fed in any order to the saw, it is necessary that they should be automatically centred on the roller feed bench before they are fed forwards into the saw vices, and for centralising, a simple, yet effective, device

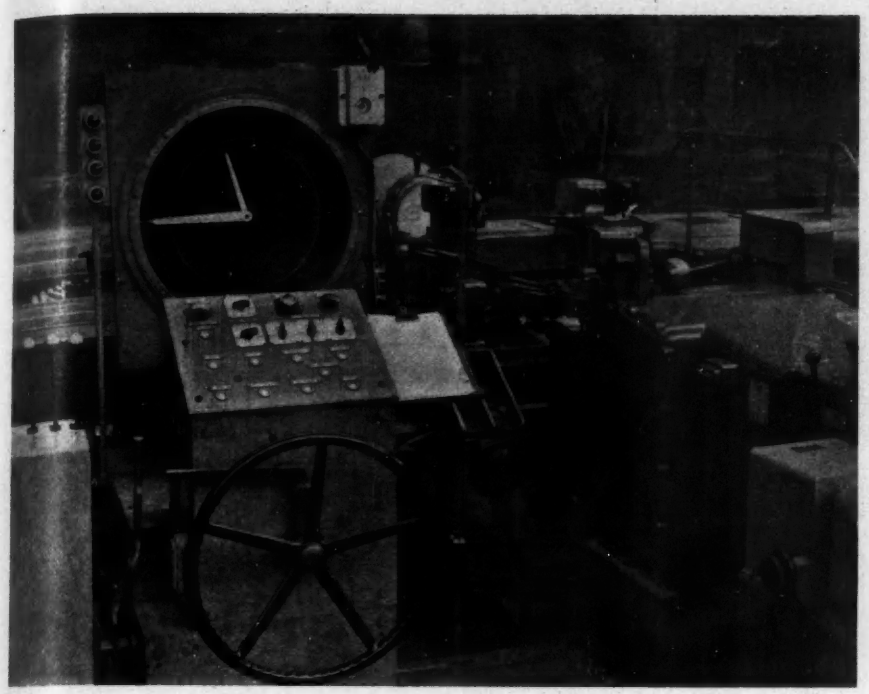


Fig. 3—Duplex Multi-Spindle Horizontal Drilling Machine

has been developed. As the bar is drawn on to the rollers, its leading edge engages a trip whilst a second trip is depressed as the bar passes over it. The two trips are mounted on opposed rack bars and the teeth of these bars are in constant mesh with a central pinion so that as the first trip is pushed outwards by the bar the second trip moves inwards the same distance under the bar. When the inner edge of the bar clears the second trip it springs up and this movement actuates a switch to cut out the feed bench motor and stops traverse of the bar in its central position on the feed rollers. It will be appreciated that initially the two trips may be spaced wide apart by the previous bar, but they are automatically centralised by the incoming bar first contacting the inner or second trip. The bar carries this trip over until its leading edge contacts the other trip which has been drawn inwards by the operation of the racks and, without depressing it, pushes it on across the conveyor, at the same time over-riding and depressing the second trip, which thereafter operates in the way described above. In the event of the trips failing to operate, the feed motor is cut out when the outer edge of the bar contacts a safety switch at the edge of the roller table.

The vertical saw, a 44in machine made by Clifton and Baird, Ltd., can be seen in Fig. 2, together with its control desk. This machine has two mechanically operated self-centring vices which are controlled from the operator's desk. It had been in service in the works for a number of years but its condition and arrangement fitted well into the layout of the new plant and only minor modifications were required to fit the machine for its new duties.

The stock bar is first fed into the saw vices by operation of the roller feed table and locked for a trimming cut to be taken off its end. Upon the vice jaws then being opened, the table motor drive is switched on to feed the bar through the machine to the required length of cut, as indicated on the work form. For setting bar length, a measuring device was developed to make possible quick and accurate individual settings. This measuring equipment is also fitted to each of the drilling machines.

When the bar has been carried through the vices, it passes on to a second roller conveyor on the other side of the machine and its end comes into contact with the arm of the measuring device. This arm moves along with the end of the bar, the length of movement being recorded in feet and inches by arms moving round the large dial, to be seen at the rear of the control desk in the illustration.

The contact arm of the measuring equipment projects from a carriage running on a track set above and on one side of the roller table. Through its carriage the arm is connected to an endless duplex chain, supported by its rollers on wires set on the track along the full length of the table. This duplex chain is maintained in constant tension by a suspended weight at the far end and it drives the measuring dial spindles through a sprocket as the contact arm moves along with the bar. The distance travelled by the carriage is, therefore, measured by chain pitches rather than absolute distance, and to ensure accuracy, means are provided to compensate for chain wear and stretch throughout the length of effective travel. In order to keep the tension in the chain low, a light drive from a small motor through a friction clutch is transmitted to the indicator dial shaft. This drive is insufficient to move the chain but overcomes most of the frictional resistance so that a small load of some 17 lb only need be applied on the contact arm by the bar as it is carried along the rollers to set the chain in motion.

As already mentioned, a similar length measuring equipment is fitted to the two drilling machines of the plant, and in each of these two cases it is used for the successive settings of the sections for drilling the holes along their lengths. The degree of accuracy obtainable with this equipment is such that holes can be drilled at 25ft centres within $\frac{1}{32}$in and well within $\frac{1}{16}$in at over 50ft centres, quickly and without call for any effort other than care on the part of the operators.

The runout table of the machine has all its rollers driven. During the measurement of a bar the operator first depresses a self-maintaining button which drives the bar through the machine at 60ft per minute. When the dial indicates that he is approaching the correct length he depresses a non-maintaining button, which reduces the speed to 3ft per minute. When this button is released the conveyor stops with power off and brakes on. For fine adjustment the operator can, if necessary, engage the handwheel at the front of his desk; this engagement cuts off power to the motor, to avoid any possibility of accident, supplies power to the brake, thus releasing it, and enables the bar to be set quickly to an exact measurement. By operating successive buttons the operator locks the bar in the vices, starts the saw, after cutting stops the saw, releases the vices and drives the cut bar out of the machine. The disposal of this bar to a storage bench is completely automatic after the movement is initiated by the push button, so that the operator is free to attend to the feeding of the following bar into the machine. As the cut bar moves clear of the measuring arm the carriage is returned towards the saw as the chain is moved in the reverse direction through a friction clutch in the motor drive of the dial spindle.

In the next machine a duplex multi-spindle horizontal drilling machine, holes in the flanges of joists and channels, or the legs of angles and tees, are drilled. This machine, details of which can be seen in Figs. 3 and 4, was built to the firm's requirements by James Archdale and Co., Ltd. Its front and rear heads are each fitted with two banks of three drill spindles, which can be moved independently in the vertical direction on the column slides.

In each bank of spindles the centre spindle is fixed laterally, the two outer spindles can be moved parallel to the work between a minimum distance of 2¼in from the centre spindle and a

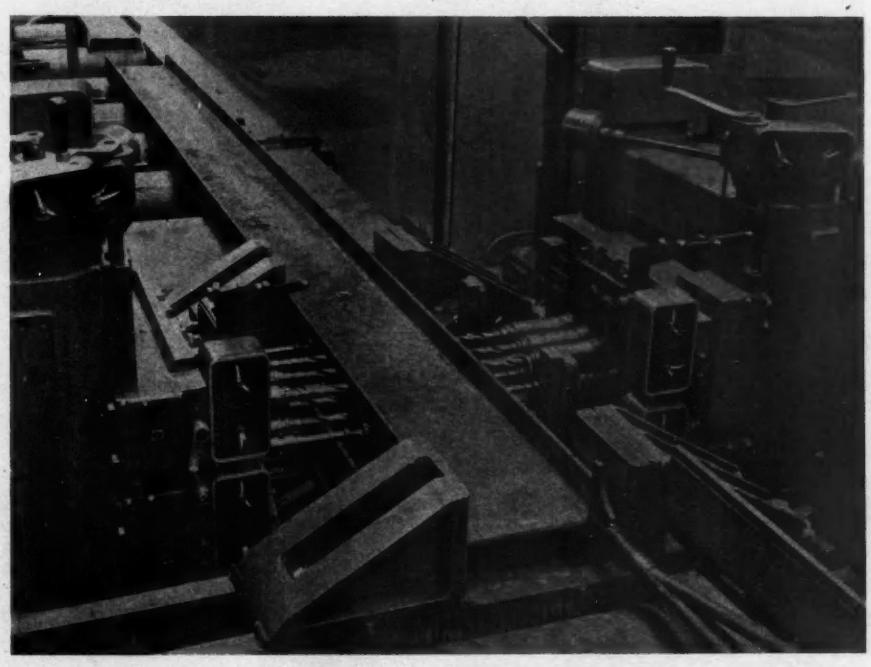


Fig. 4—Drilling Bar in Horizontal Drilling Machine

maximum of 6in. The two lower banks can be set with the spindle centres down to within ¾in above the top face of the machine table rollers. The two upper banks can be raised to give a maximum spindle centre distance of 10¾in above the table. With this range of spindle adjustment within the banks, and the bank adjustment in the vertical direction, a pattern of holes can be drilled from either side in a rectangle from 4½in wide by 2½in high to 12in wide by 10¾in high. By adopting this arrangement it is possible for all holing patterns used in structural work to be drilled without difficulty, provided the centres are 2½in or more. The spindles are fitted with No. 3 Morse quick-release sockets, which have an end adjustment of 1in to accommodate different drill lengths. Drills from $\frac{1}{16}$in to 1¼in diameter can be used on the machine.

It is not always necessary to use all three drills of a bank at one working stroke, or both of the heads. The controls of the machine are therefore arranged so that either or both heads can be used, and any one, two or all three drills in the banks. For operating spindle selection a system of "gags" is fitted to each bank. When its "gag" is raised a spindle slides back into its housing on the drill contacting the work whilst the other drill or drills are cutting. These gags consist of U-shaped yokes, which, by operating hand levers, are slid over the spindles behind thrust collars to prevent the spindles retracting. By using these gags any number of holes up to twelve can be drilled without need for removing the drills.

The position of each of the four outer spindles in the two banks on each head of the machine is adjusted by means of a simple crank handle, with reference to a setting dial graduated in inches and fractions of an inch. These dials can clearly be seen at the end of the spindle banks in Fig. 4. The two similar setting dials to be seen at the top of each column are used to indicate the centre height setting of the two banks. With these dials it is stated that spindle centre and height settings to within 0·015in can readily be made.

All movements of the machine are controlled by push buttons from the operator's desk. On the start button being depressed the heads move forward at the fast traverse rate of 16ft per minute until the drills are just clear of the work face. The infeed rate then automatically changes to cutting speed, and when the drills have broken through a quick-return movement is made to the starting position. A hydraulic feed gives an infinitely variable range of drilling speeds, up to 6in per minute, to the heads. Four drilling spindle speeds from 120 to 465 r.p.m. are available.

The head of the machine on the control side is adjustable between 28½in and 14½in from the face of the front fixed vice jaw, its working stroke thus being 13½in long. The rear head has a working stroke of 32½in being adjustable from 55in to 22½in from the fixed vice jaw.

As already mentioned the work is introduced and indexed through this machine on a roller conveyor similar to that of the sawing off section, and on the first infeed, measurement starts as the end of the bar reaches the centre line of the central fixed axis drills of the four banks. Four driven rollers which form the machine table are part of the main roller conveyor system.

When the work is in the required position in the machine, it is gripped by two hydraulically operated vices. In order to hold the bars or sections firmly when they are being drilled near their extremities, and the loading ends have not reached the second vice, a supplementary hydraulic clamp is fitted to grip one of the lower flanges in close proximity to the drill heads.

In order to remove the large amount of swarf produced on this machine, a shaker conveyor has been installed below floor level under the swarf chute. This conveyor carries the drillings out to a pit at the side of the machine where they fall into a hopper which can easily be removed for emptying.

From the horizontal drilling machine, the bars are run out on the roller conveyor, off which they are skidded sideways on to transverse racks leading to the feed roller conveyor of a vertical drilling machine. This multi-spindle drilling machine, also made to the firm's requirements by James Archdale and Co., Ltd., is used for drilling the webs of joists and channels, bridge and flat bottom rails, flats, &c., up to 27in wide. The machine, as can be seen in Figs. 5 and 6, has its columns set on each side of the roller conveyor to support the bridge carrying the drilling head, and it forms a tunnel 14½in high by 30in wide over the work table rollers. The drilling head has four spindles which are adjustable across the width of the bridge by means of handles, and with reference to setting dials, as in the case of the horizontal drilling machine. The drill spindles can be set at minimum centres of 2½in, and each is fitted with a "gag" to bring it into operation, so that the required number of holes can be drilled without removing the drills. The head is actuated by hydraulic feed at infinitely variable rates from 0in to 6in per minute. When the automatic drilling cycle is initiated by depression of a push button on the operator's desk, the head descends at an approach rate of 16ft per minute until the drills are just above the bar, and then the preset feed rate comes into effect. At the end of the drilling operation the head returns at the fast speed to the starting position. Four spindle speeds from 120 to 465 r.p.m. can be selected through a gearbox. A hydraulic vice on the centre line of the drills clamps the work. As can be seen in Fig. 6, up to four joists can, if required, have their webs drilled in one operation. Provision has been made on both of the drilling machines for the clamping of the drilling spindles after setting, but it has been found that they retain their settings without need for this precaution.

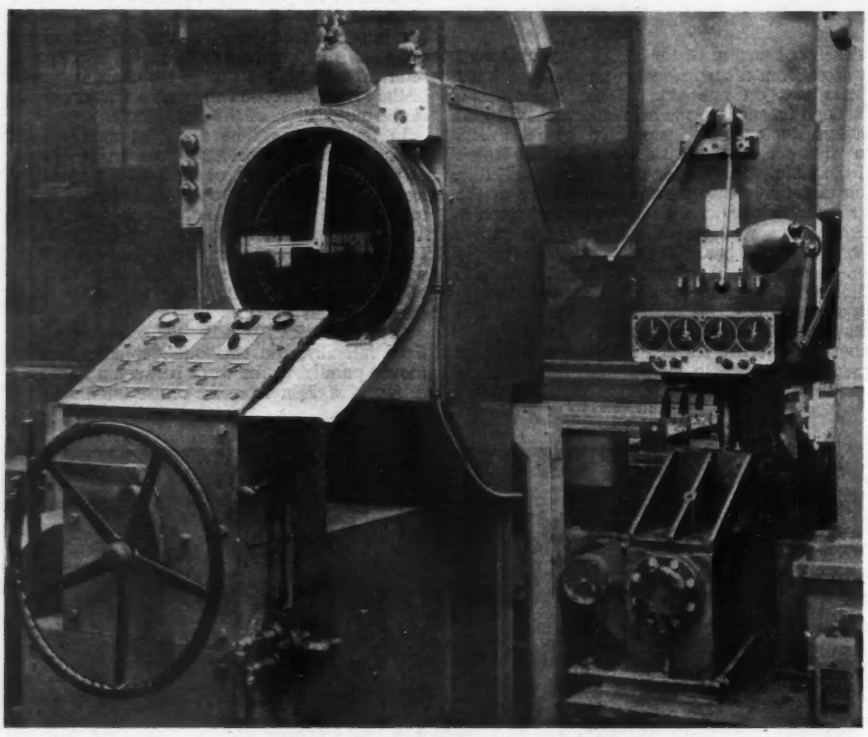


Fig. 5—Vertical Multi-Spindle Drilling Machine

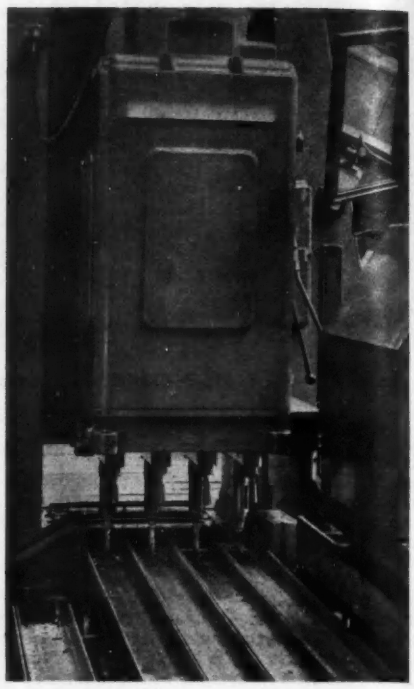


Fig. 6—Drilling Bars in Vertical Drilling Machine

From the vertical drilling machine, the bars are run on to assembly benches where the necessary fittings, which have been previously prepared by similar methods, are attached.

Throughout this plant Boulton and Paul, Ltd., has paid great attention to the safety of men and machines. Stop switches have been installed in all the positions where danger might arise and, in addition, the various electrical controls have been interlocked to ensure safe operation. For example, as it would be dangerous for a bar to be drilled in the horizontal machine unless it is gripped in the vices, the circuits are so arranged that the heads cannot move forward unless the vices have been closed. Again, many of the movements of the bars, particularly on the outgoing sides of the machines, are automatic, for, as these movements are controlled by the bars operating various trips and switches, the damage that could be caused by the failure of a switch would be considerable. Consequently, all limit switches situated where danger might occur have been duplicated so that in case of failure a second switch takes over the control. Finally, all the circuits have been arranged so that any failure will be "to safety."

An Improved Air Hoist.—We are informed by Metalmacs, Ltd., of Much Park Street, Coventry, that an improved method of control is now fitted to its vertical air hoists which are made in four sizes with capacities from 2 cwt to 10 cwt. With this new twist grip control the lifting piston can be moved up and down at a quick or a slow rate by simply turning the grip with one hand whilst guiding the load with the other hand.

Atomic Test Explosions

(By Our American Correspondent)

OFFICIAL security regulations being what they are, no one expects detailed information on the recent tests of atomic bombs and other weapons which have been conducted on the Yucca Flats proving ground near Las Vegas, Nevada. The first detonation in the recent series on March 17th was accompanied by much theatrical effort aimed at improved "public relations"—through newspaper, wireless and television coverage, millions of Americans became somewhat more familiar with what to expect from an A-bomb. At the invitation of the U.S. Atomic Energy Commission, scores of reporters went to Nevada to witness these latest tests of what are enigmatically called "new and improved nuclear devices." A few of the reporters, chosen by lot, huddled in trenches and saw more of the atomic explosion than outsiders were ever permitted to see before—more because they were closer. For all this nearness to the 300ft tower from which an atomic bomb of an unidentified type was suspended, the accounts that came from Nevada were literary exercises rather than revelations of scientific importance. The public was regaled with some purple prose, but not with technical facts. It was not the fault of the reporters, but of the security regulations. Despite the paucity of information, newspaper readers were justified in inferring that the tests were carried out for two purposes. One was to find out how ordinary dwellings and their occupants would fare if they were within a mile and a half of an atomic blast. The other was to determine the tactical importance of "nuclear devices" which can be dropped from fighter aircraft or hurled in guided missiles or fired from a 280mm mobile gun driven by two powerful tractors at a speed that may be as high as 35 miles an hour.

Of the two identical wood-frame, two-storey houses which were subjected to the blast, one was situated at a distance of 3500ft from the blast. It was completely demolished in two and a third seconds. The other one, 7500ft away, fared better. Both houses were "inhabited" by life-like dummies—the mute counterparts of an average family. The dummies within both houses were tossed about, with the probability that living human counterparts would have been killed. The second structure was not reduced to a ruin. Its shell survived the blast. But joists were pulled away, roof beams were visibly damaged, plaster fell, window sashes were torn out. The heat set the front of the nearer house on fire, but in a fraction of a second the blast wave extinguished the flames. The experiment with these two houses was of importance because it taught a good deal that ought to be known about civil defence precautions and shelters. On the tactical value of nuclear devices it is far more difficult to express an opinion. In the Nevada tests the "nuclear device" that was exploded was the equivalent of 15,000 tons of T.N.T. The A-bomb of 1945 had a rating of 20,000 tons of T.N.T., which is still the "standard." Evidently, atomic bombs are smaller than they were five years ago, which means they may be useful on the battlefield. How effective tactical "nuclear devices" will be in ground warfare is, however, still a matter of considerable dispute. Blast and the heat that follow an explosion of an atomic bomb or shell may be fatal to unsheltered troops within a range of half a mile. There is no certainty about this. The well-known experiments conducted during the last war by Professor S. Zuckermann, of the University of Birmingham, with goats in trenches showed that blasts of ordinary high-explosives are not nearly as deadly as the military authorities supposed they were. His goats survived blast pressures far in excess of the estimates. Even the blast of an atomic bomb will not necessarily kill, though it may fell many a soldier in a near-by shelter. Heat is more to be feared. Severe burns may be expected within a range of a mile of an atomic explosion. If tactical nuclear devices are developed, we shall hear more of trenches and dugouts, both of which afford good protection. But battles are won by charging troops and not by soldiers huddled in trenches and dugouts. Lastly, there is the new danger that lurks in radio-activity. In the Nevada tests of 1952, troops were stationed in dugouts at approximately 7000 yards from "ground zero"; in the present tests this distance has been reduced to only 3500 yards. Fifteen minutes after the recent explosion, two battalion combat teams moved out of the trenches and forward, accompanied by monitors who carried Geiger counters. Nevertheless, the radio-activity of contaminated ground is a real danger. The effects of exposure to radiation may not be apparent for days. But when they do appear a general may find it necessary to send hundreds, even thousands of men, to hospitals for prolonged treatment, with the certainty that many will die.

It is clear from the accounts that have so far come from Yucca Flats that more attention than ever will be paid to the effects of atomic explosions in future. The structural engineer has, perhaps for the first time, received certain definite information on the behaviour of a wooden frame structure as the result of an atomic bomb explosion, where previously he had to go almost entirely by the not very accurate reports on what happened at Hiroshima in 1945. The design of the house employed in the recent test was one of ten selected by the Federal Civil Defence Administration in co-operation with the American Institute of Architects and has been pronounced "typically American." In view of the predominance of masonry construction in most countries of Western Eruope, it is to be regretted that a brick dwelling was not also included in the tests. Furthermore, it is to be hoped that now the A.E.C. has made a start at releasing pertinent information relating to atomic test explosions, it will become more liberal in this respect and provide both the public in general and engineers in particular with the knowledge so badly needed to dispel the ignorance and consequent fears present in the field of atomic warfare and its effects.

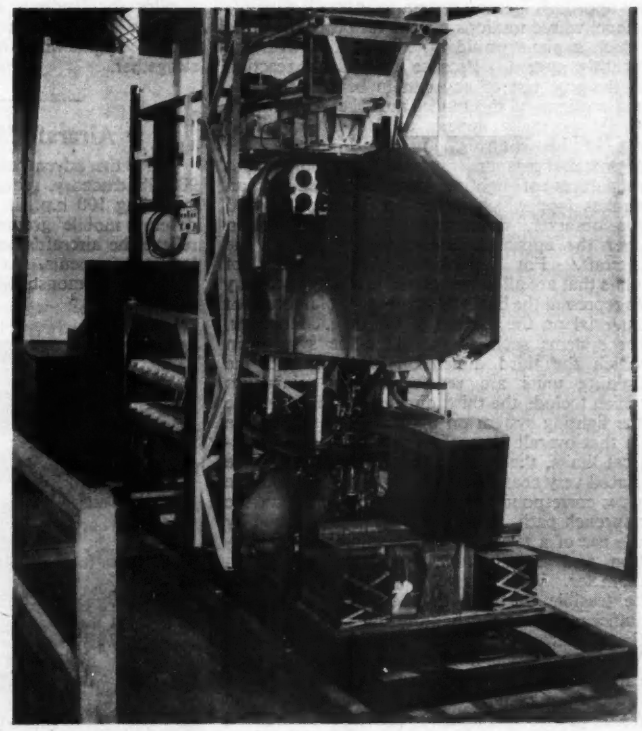
AGRICULTURAL ENGINEERING SCHOLARSHIP.—The Institution of British Agricultural Engineers announces that the *Farm Mechanisation* scholarship for the final year's course of study for the National Diploma in Agricultural Engineering has been awarded to Mr. L. T. Edge, of Redditch, Worcestershire.

American Engineering News

(By Our American Correspondent)

A Device for Evaluating Airport Approach Lights

Although extensive flight tests have been made, both in the United States and abroad, to determine which of many proposed airport approach light systems is best suited for the landing of aircraft in fog, these tests have thus far failed to bring about agreement on any one system. As a contribution to the work being undertaken in this field, the National Bureau of Standards, in co-operation with the U.S. Navy Bureau of Aeronautics, has developed a device, known as the "kinorama," with which a pilot can evaluate the guidance provided by a system of approach lights without leaving the ground. It is felt that a more important function than that of evaluating the approach light system will be the use of this apparatus in providing pilots with the training for landing in fog which can now be acquired only through hazardous experience. The use of the kinorama makes it possible for the pilot to see an approach light configuration speeding by him just as he would in flying over it in fog. The course followed in such a simulated flight is determined by the pilot himself, who acts in response to the lights which are visible to him. By recording the paths thus followed, it is possible to obtain objective records reflecting the merits of the light system. While the device is not considered to be a substitute for flight testing for the final approval of a system, it is inexpensive, objective, free from hazards, and not dependent upon the occurrence of fog.



Front View of Prototype "Kinorama"

It is generally agreed that, in spite of the excellent electronic equipment which has been developed for guiding pilots in fog, safe landings in bad visibility are not yet a common practice, because there remains the problem of making the final contact with the runway. Where so much is at stake, it is desirable, if possible, to make this final contact visually rather than to trust the operation of electronic devices. It is the purpose of the approach lights to furnish an earlier visual contact with the ground. Many engineers and pilots have attempted to design systems of lights to guide pilots in the critical seconds between the time the aircraft is near enough to the ground to be within the reach of lights and the pilot's first sight of the

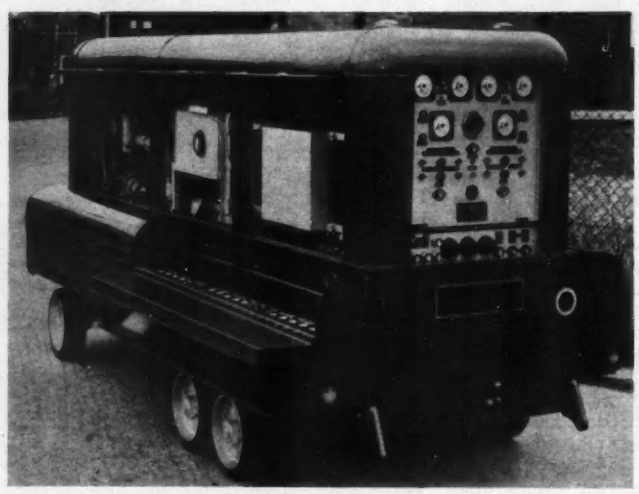
runway lighting. Practically all discussion of the merits of these different systems has revolved about stationary aspects of their designs, such as the interpretation of geometrical figures, the visual range of the lights, and the possibility of seeing lights in different positions. It is quite evident, however, that approach lights cannot be seen in stationary arrangements by pilots except in the unusual cases of fixed balloons and helicopters. For some time now, the "cyclorama" device for simulating visual landings in bad weather has been in use at the R.A.E. at Farnborough. This device, however, is limited to configurations in a single plane and, hence, cannot be used for evaluating a three-dimensional arrangement of lights such as the slope-line system. The "kinorama" designed at the N.B.S. undertakes a more complete simulation and includes the three-dimensional aspects of approach light systems. After the original model had demonstrated that it is possible to achieve the desired flight simulations, it was decided to construct an improved prototype kinorama, which is illustrated on page 875.

The basic principle of the device is to represent an approach lighting system by a small, movable model whose motions are the reciprocal of those which a plane would have in landing over the lighting system. Because the pilot's reaction is the true test of any system being evaluated, the motions of the model must be those which would normally appear to follow the pilot's use of his controls. In the kinorama, the approach lights are represented by fluorescent miniatures of lighting units mounted on an endless tape which moves continuously toward the observer, simulating the forward motion over the approach and runway lights of the aircraft. For lighting systems composed of units that are all in one plane, it is only necessary to represent the lights by small spots of fluorescent material on the surface of the tape. However, for systems such as the slope-line system, in which the third dimension is significant, the lighting units are represented by miniatures which include the third dimension. To simulate the lighting system on a sufficiently small scale so that overall dimensions are kept within practical limits, the point of observation had to be placed very near to the tape in order to make the view correspond to that from points along the approach path. This has been accomplished by the use of a telescope with negligible magnification and an objective approximately ½in in diameter. With a larger objective, it would not be feasible to bring the point of observation sufficiently near the lighting units and only the first stages of an approach could be simulated. With a telescope of sufficient length the pilot can sit in his seat normally and see the lights as if he were coming down among them. The telescope also simplified the problem of simulated banking. It was only necessary to install a dove prism at a suitable point in the telescope and rotate this prism to obtain a realistic simulation of a lighting system as seen from a banking aircraft. The original laboratory model was built on the fuselage of an aircraft with its associated instruments and controls. Hinged plywood platforms, which moved relative to one another, provided the apparent motions of flight. In the subsequent prototype model, the cockpit, instruments, and controls of a Link trainer have taken the place of those of the aircraft and the plywood platforms have been replaced by rectangular frames of aluminium alloy. A true vertical motion has been substituted for the hinged movement. All the angular motions are simulated optically, which simplified the mechanical design and made it possible to provide the desired yaw movements with less width. Servomotors control all movements of the "kinorama," including a recorder which provides a permanent record of each "landing." Special equipment is incorporated to allow the automatic presetting of any one of nine initial landing states, i.e. the selection of one of nine combinations of three altitudes with three transverse positions, combined with a predetermined yaw, bank and pitch for each state. This flexibility of presetting has been found sufficient to meet the needs of a wide variety of landing problems.

So far, an evaluation of three different systems of visual aids has been undertaken with the "kinorama": (1) a comparison of three "overrun" lighting systems which were designed at the Wright-Patterson U.S. Air Force Base, utilising different designs of lighting units; (2) a comparison of the three approach light systems proposed for standardisation by the International Civil Aviation Organisation, and (3) a study of longitudinal and transverse markings for runways. The results of the N.B.S. tests with the "overrun" systems and the runway markings have shown satisfactory agreement with corresponding flight tests. The investigation of the approach light systems is as yet incomplete; preliminary results obtained with the laboratory model will be supplemented by tests with the prototype model. In addition to its usefulness for evaluating lighting systems the "kinorama" is expected to become a valuable training device. The use of approach light systems in good weather does not make a pilot proficient in using them in fog. The irregularity and suddenness with which fogs occur, on the other hand, make it impracticable for a pilot to obtain his training by gradually flying in more and more difficult weather. The kinorama can be used to supplement experience in landings with moderately low ceilings and prepare a pilot for landings in actual fog, making it possible for him to complete landings with approach lights when the weather has deteriorated altogether.

Aircraft Starting Unit

WITH the advent of turbo-jet engines in the 9000 lb category, requiring starting horsepower exceeding 100 h.p., it has become necessary to develop mobile ground starting units, and so relieve the aircraft's secondary batteries of such load requirements. At London Airport recently, a starting demonstration was carried out on a "Comet" aircraft using a starting unit which has been designed jointly by Auto Diesels, Ltd., Uxbridge, and Crompton Parkinson, Ltd., and adopted by British Overseas Airways Corporation. The prototype was originally designed for the "Sapphire" engines of Handley Page "Victor" jet bomber, and the unit now being supplied to B.O.A.C. is a more powerful installation which, it is thought, will accommodate all jet engine starting requirements likely to be involved in civil transport operation for many years.



Mobile Starting and Servicing Unit

The unit consists of a diesel engine driving two generators giving outputs of 450A continuously at 112V, and 750A continuously at 28V. In addition, the unit will supply peak starting currents of 850A at 112V, and 2000A at 28V. Simultaneous outputs for 28V servicing and 112V starting are permissible up to 112kW.

Apart from supplying the peak power for engine starting, these units will also provide electrical power for pre-flight servicing and testing. The maximum current output is obtained by using an engine rated to provide for the peak loading conditions without supercharging or speed boosting. For diesel-driven equipments the engine incorporated is the Leyland 11·1 litre engine for which world-wide servicing facilities are available. This engine develops 154 b.h.p. at 2000 r.p.m.

The compound-wound generators are built to a special design by Crompton Parkinson, Ltd., to meet the exacting requirements of this application, and, for the first time, without the use of automatic voltage regulators. Close regulation is achieved, without the oscillatory surges associated with automatic voltage regulators, when dealing with sudden and wide load changes. Tests have proved that inherent voltage regulation is held even with shock loads of 500 per cent above full-load current.

The unit includes two batteries giving 24V and 96V respectively. When the generating set is running the 24V battery is connected in parallel with the 28V generator and the 96V battery in parallel with the 112V generator. With this arrangement the batteries are charged when the set is running. When the set is giving a 28V supply for servicing, if the generator is switched off, or the engine is shut down, for example, during aircraft refuelling, the servicing supply is maintained from the 24V battery which can also be used in the event of a starting supply being required when the set is shut down. The 96V battery is provided only for starting when the set is shut down. Either battery is only used for starting if it is essential during refuelling or in an emergency.

Control and protective gear is designed for foolproof operation. A push-button-controlled contactor system enables individual selection of any or all supplies. The contactors are of high-speed, heavy-duty, solenoid-operated design. Contactor closure is indicated by panel pilot lamps and also by vehicle roof lamps for aircrew observation. The controls are centralised on a single panel with separate sections for 112V and 28V switching.

Positive protection is provided against overload, generator overvoltage and reverse current (resulting from feedback from aircraft batteries or generators) by means of a new technique employing high-grade sensitive relay instruments and associated high-speed main contactor tripping relays. Reverse current tripping operates at minus 2 per cent of full-load current. The generator contactors can be closed only when the generated voltage is in excess of the associated battery volts and cannot be closed if the generator polarity has been reversed while the set is shut down. The latter safeguard is provided by a unidirectional high-speed relay. All contactors incorporate a "no-volt" release whereby, on aircraft plug disconnection, automatic tripping will occur without sparking. All fuses are of the replaceable, Edison screw indicating pattern.

The ground power unit is mounted on a four-wheeled trailer with a low centre of gravity.

SERIA OILFIELD.—The eruption of two geysers of gas and mud caused the Seria Oilfield, British Borneo, of the Shell Petroleum Company, Ltd., to be partly closed down for safety reasons. As a result the production rate was reduced to 1·5 million tons per annum through the closing of five production stations until the pipeline system was re-routed when the annual production rate was restored to 5 million tons.

FLAMEPROOF BARRIER BOX.—The General Electric Company, Ltd., has designed a flameproof barrier box for connecting conduit entering an inflammable atmosphere from a non-inflammable atmosphere or *vice versa*. It is fitted with four 20/25A terminals, is suitable for use in circuits up to 660V and has two 1in E.T. outlets on both incoming and outgoing sides. It has been approved by the Ministry of Fuel and Power for use in gases of Groups II and III and has been awarded Buxton Certificate FLP 3027 (November, 1952).

Industrial and Labour Notes

Britain's Overseas Trade

The Board of Trade has issued some provisional figures concerning Britain's overseas trade during May. They give the value of exports in May as £211,700,000 for twenty-five working days. In April the total value of exports was £214,800,000 for twenty-four working days, so that the average for the two months was £213,300,000. This, the Board of Trade says, represented a small increase per working day over the average of both the first quarter of this year and the final quarter of 1952.

Imports in May were at a high level, the total value being £296,400,000, compared with £293,300,000 in April. Over the first five months of this year the monthly average value of imports was £281,200,000, compared with £263,300,000 in the second half of last year and £290,100,000 over the whole of 1952. The value of re-exports in May was £7,200,000, giving an average of £8,100,000 for April and May, compared with £10,000,000 a month in the first quarter. The excess of imports (c.i.f.) over exports and re-exports (f.o.b.) increased in May to £77,500,000, bringing the average so far this year up to nearly £62,000,000 a month, compared with £63,000,000 a month for the year 1952.

Iron and Steel Production

Production in the British iron and steel industry continues to rise. The figures for May show that, despite the Whitsun holiday, the output of steel ingots and castings averaged 350,700 tons a week, which represented an annual production rate of 18,236,000 tons. Last year in May the annual production rate was 16,245,000 tons. Pig iron production in May averaged 214,700 tons a week and was thus at an annual output rate of 11,165,000 tons, compared with 10,456,000 tons in May last year.

Iron and Steel Holding and Realisation Agency

In a written answer to a Parliamentary question at the end of last week, the Chancellor of the Exchequer, Mr. R. A. Butler, stated that he had appointed the Iron and Steel Holding and Realisation Agency in accordance with the provisions of the Iron and Steel Act, 1953. The Act prescribed that, in addition to the chairman, the Agency should be composed of not less than three nor more than six members, and, for the moment, the Chancellor said, he had appointed five members in addition to the chairman.

Sir John Morison, of Thomson McClintock and Co., the reply continued, had agreed to become chairman of the Agency at a salary of £6000 a year. He was surrendering those of his directorships which could conflict with his duties as chairman of the Agency. Sir John Green, at present chairman of the Iron and Steel Corporation of Great Britain, had agreed to serve as a member of the Agency at a salary of £3500 a year, and would take up his appointment when the Corporation was dissolved. The Chancellor explained that Sir John would devote the greater part of his time to the business of the Agency. The other appointments, each carrying a salary of £1000 a year, were of Mr. A. C. Bull, Sir Thomas Chadwick, Sir Oliver Franks, and Mr. C. P. L. Whishaw.

Government Stocks of Zinc

As there have been some reports that the Ministry of Materials has large stocks of zinc for disposal, the Ministry has stated that when the arrangements for zinc stock disposal—which were announced last December—come to an end in July, and after transfers to strategic reserves, the remaining stocks for sale will be about 70,000 tons. It is proposed to sell these limited quantities of zinc gradually over a period. The Ministry says it is satisfied that, with world zinc production running at an annual rate of around 2,000,000 tons, the effect on the balance of supply and demand will be insignificant. There are to be early discussions with the trade on disposal arrangements, in the light of which talks the actual rate of sale will be decided. The Ministry says also that, in addition to disposals from stock, it will continue to sell zinc bought from current production under contracts made during the period of public trading.

Incentive Schemes in Building and Civil Engineering

About a year ago, the Ministry of Works made an inquiry into incentive and bonus payment schemes in the building and civil engineering industries. Questionnaires were sent to sites in England, Wales and Scotland where new works of more than £1000 in value, and maintenance and repair work costing over £2000, were being carried out. Contractors were asked how many of their operatives were paid under an incentive system of bonus payments related to output, and returns were received from 26,000 sites covering 305,000 men.

The Ministry of Works has now published some details about the results of this inquiry. It says that in England and Wales 29 per cent of the sites which made returns had incentive schemes based on output, national agreements permitting the operation of such schemes having been in force since November, 1947. The proportion of men covered by incentive schemes out of the total employed on the sites included in the returns amounted to 41 per cent. In Scotland, where a similar national agreement did not come into force until March, 1950, there were 21 per cent of the sites in the return which had incentive schemes and 28 per cent of the men covered by the survey worked under some system of bonus payments.

The analysis shows that the operation of incentive schemes was more widespread on sites where the work amounted to over £50,000 in contract value; in England and Wales 61 per cent of such sites had incentive schemes, and in Scotland 52 per cent. Incentive schemes were found in many different classes of work. In civil engineering projects and power station construction, for example, in England and Wales, the proportions of incentive schemes were 45 per cent and 44 per cent respectively, and in Scotland 20 per cent and 22 per cent. In general building work, bonus schemes were most frequently operating in school building, the proportion being 30 per cent in England and Wales and 21 per cent in Scotland. In maintenance and repair work 22 per cent of the sites in England and Wales where projects costing over £2000 were in progress had incentive schemes, the comparable figure for Scotland being 13 per cent.

Engineering Wages

At the annual conference of the National Union of General and Municipal Workers last Monday, there was some discussion of the claim for a 15 per cent increase in engineering wages which has been advanced recently by the Confederation of Shipbuilding and Engineering Unions. The National Union of General and Municipal Workers is said to have about 150,000 of its members employed in the engineering industries, mainly as unskilled workers.

During the discussion Mr. Matthews, the national engineering organiser of the General and Municipal Workers, said that the executive felt that the claim should be on a "bread and butter" basis and that there was no case for a skilled man obtaining a greater increase than an unskilled man. As the application stood, a skilled man would get an increase of £1, an unskilled man an increase of 17s. 6d., and a woman 12s. 6d. Mr. Matthews went on to say that the suggestion of the National Union of General and Municipal Workers was that the application for an increase should be for a uniform amount all round, but the craft unions had asserted that the differential between skilled and unskilled should be widened. His answer to that was that the way to set about it was not on a "bread and butter" issue, but by establishing a new wages structure. But the percentage increase had now been accepted as the Confederation's policy. It was to be hoped, Mr. Matthews added, that the Confederation would not get into the same position as last year or the year before, when money was kept out of the workers' pockets by long negotiations. Unless the Confederation was realistic in wage applications, there would be budgeting for unemployment through the engineering industries being priced out of world markets.

The Census of Production

The Board of Trade has made the Census of Production (Returns and Exempted Persons) Order, 1953, which indicates the scope of the census to be taken in 1954. As already announced, sampling methods which were introduced for the first time for the census in 1952 will again be used, with the result that next year's census form will contain few questions. The decision to take a simplified sample census for the second year in succession was made after consultation with the Census of Production Advisory Committee.

The census will cover all producing industries, as before, and returns will be required from all firms over a certain size in each trade. A sample will be taken of the medium-sized and smaller firms, however, which means that the majority of such firms will not be required to make a return. The statutory form of return will include questions on the number of working proprietors, average employment during the year, wages and salaries, expenditure on plant, machinery and vehicles and also on new building work, total cost of materials and fuel purchased, total amount paid for work given out, value of stocks at the beginning and end of the year of return, total value of output, and transport payments. Undertakings producing coal, gas, electricity, oil shale, crude or refined petroleum, or shale oil products are exempted from making a census of production return to the extent to which they supply the necessary information to the Minister of Fuel and Power.

The Board of Trade has also announced the appointment of the statutory advisory committee, under the chairmanship of Mr. J. Stafford, on the preparation of forms and instructions for the census of production to be taken in 1955 in respect of 1954. It is pointed out that this committee is distinct from the special committee recently set up under the chairmanship of Mr. W. R. Verdon Smith to advise the President of the Board of Trade on future policy as to the taking of censuses of production and distribution.

Industry and the Government

Speaking at the annual general meeting of the Dunlop Rubber Company, Ltd., on Monday last, the chairman, Lord Baillieu, said that whilst much remained to be done to strengthen the financial and productive basis of industry, the accumulating evidence of an important change of direction in Government policy was to be welcomed. At last, it seemed that we were shaking ourselves free of the restrictions and negative thinking which were so often generated by a long war. Controls and licences were being progressively removed, shortages of many raw materials and of consumer and capital goods seemed to be slowly disappearing, industry and the individual were being thrown more upon their own resources, and incentives were being revived to call forth the latent resources and energies of the nation. It was to be hoped, Lord Baillieu continued, that the Government would not weary of well doing, for he felt confident that industry itself would recognise the continuing challenge of the change of direction in Government policy.

Notes and Memoranda

Rail and Road

RAILWAY ENGINEER'S RETIREMENT.—The London Midland Region of British Railways has announced the retirement, on account of ill-health, of Mr. Christopher James Chaplin, assistant engineer (works maintenance), Euston. Mr. Chaplin began his railway career in 1929 as a draughtsman with the L.M.S. in the district engineer's office at Walsall.

BANBURY MOTOR-CYCLE RUN.—The fourth annual Banbury run for veteran and vintage motor-cycles is to take place on Sunday next, June 21st, the first competitor starting at 10 a.m. from the Crown Hotel, Banbury. This year there is a record entry of 250 machines. The run is to Coventry and back, a distance of about 62 miles.

STEAM ROLLER FOR BIRMINGHAM MUSEUM.—A single-cylinder steam roller, built by Aveling and Porter in 1892, has been restored by Hunt Brothers (Oldbury), Ltd., and presented to the Science and Industry Museum in Birmingham. The roller was owned originally by Mr. George Law, a contractor, of Kidderminster. It was the first to be registered in Worcestershire, the eighth registration in Warwickshire, and the eleventh in Staffordshire. The original registration plates have been retained.

BRITISH TECHNICIANS IN INDIAN LOCOMOTIVE FACTORY—The Locomotive Manufacturers' Association of Great Britain is assisting the Government of India in the development of the Chittaranjan locomotive works, which forms one of the projects of the India Five-Year Plan. The Locomotive Manufacturers' Association is giving assistance under an agreement which provides for technical advice on the most efficient and economical methods of providing locomotives and boilers at Chittaranjan ; it includes the provision by the association of skilled supervising and production staff for the works and of facilities for the training of Indians in the workshops of British manufacturers, and the supply of equipment and components as required until the Chittaranjan works are in full operation. A technical consultant provided by the L.M.A. visits the works about twice a year and a production adviser, Mr. J. C. Spark, formerly a works manager at the Doncaster locomotive works, is resident at Chittaranjan. Six British technicians supplied by L.M.A.—experts in boiler building, welding, locomotive frame erection and machine shop practice—are also working there. The Government of India, through the Technical Co-operation Bureau of the Colombo Plan, in Colombo, applied further for the loan of the services of five operator-demonstrators, experienced in the handling of machine tools, and six rate fixers, and the British Government agreed to provide this additional aid under the Technical Assistance Scheme.

Air and Water

INSHORE MINESWEEPER.—Her Majesty's Inshore Minesweeper, " Damerham," which has a length of 106ft 5in by 20ft 6in beam, and is designed to operate in shallow waters, was launched without ceremony from the shipyard of Brooke Marine, Ltd., at Oulton Broad, Lowestoft.

PRODUCTION OF THE " GANNET " AIRCRAFT.—The first production version of the " Gannet " anti-submarine aircraft has made its maiden flight and has been delivered to the Ministry of Supply. The machine was built at the works of the Fairey Aviation Co., Ltd., Hayes, Middlesex, where the " Gannet " is in super-priority production.

ROYAL RESEARCH SHIP.—The Colonial Office states that H.M. The Queen has been pleased to approve the redesignation of the Falkland Islands Dependencies' survey vessel " John Biscoe " as the Royal Research Ship " John Biscoe." The " John Biscoe "—which took part in the Coronation Naval Review—is a wooden-hulled vessel of about 900 tons, and was purchased by the Falkland Islands Dependencies' Government in 1947. During the war, the ship served with the Home Fleet as a naval netlayer.

INSTITUTE OF MARINE ENGINEERS.—The council of the Institute of Marine Engineers announces two essay competitions, in each of which a prize of £20 is offered for the best essay on any subject of marine engineering interest. The first competition is open to members of the Institute of any grade, and the second to students and graduates only. The essays, which should be between 1500 and 3000 words in length, must be delivered by October 1st next. Full details of the competitions are available from the Institute of Marine Engineers, 85, Minories, London, E.C.3.

Miscellanea

INSTITUTE OF WELDING.—H.R.H. the Duke of Edinburgh has been pleased to accept Honorary Fellowship of the Institute of Welding. He was formally elected to this class of membership by the council of the Institute at its meeting on June 10th.

CEMENT FACTORY IN HUNGARY.—It is reported that work has begun on the construction of a new cement factory on a 370-acre site near Vác, on the northern bend of the Danube in Hungary. Its main building, 360 yards by 65 yards, will house two rotary kilns, each 165 yards long, for production of clinker.

COAL MINING IN CANADA.—The Department of Mines and Technical Surveys, Ottawa, has issued a report on coal mining in Canada. It gives the total coal production for last year as 17,516,370 short tons and states that in the Canadian coalfields 278 operating concerns were engaged, only five of whom each produced more than 1,000,000 tons.

NATIONAL SMOKE ABATEMENT SOCIETY.—The National Smoke Abatement Society is proposing to establish a South East Divisional Council to include the area covered by Bedfordshire, Berkshire, Buckinghamshire, Essex, Hampshire, Hertfordshire, Isle of Wight, Kent, London, Middlesex, Oxfordshire, Surrey and Sussex. A meeting of members of the Society in this area is to be held at Caxton Hall, Westminster, S.W.1, on Friday, June 26th, at 2.30 p.m., to discuss the matter in detail.

" THE MODEL ENGINEER " EXHIBITION.—We are informed that " The Model Engineer " Exhibition will be held at the New Royal Horticultural Hall, in London, from August 19th to 29th next. This exhibition will include a passenger-carrying live steam track ; a steam-driven scale model roundabout ; a miniature Grand Prix track and a water tank where radio-controlled model yachts and boats will be seen manœuvring. In the demonstration area all branches of engineering in miniature will be shown and explained.

AN INDUSTRIAL FACE GUARD.—A new product of the protective industrial clothing division of the R.F.D. Company, Ltd., of Godalming, Surrey, is a shoulder-braced face guard. In this special equipment for facial protection, the transparent shield is firmly supported by comfortable felt-lined shoulder braces. A light chemical-proof or flame-proof fabric bib attached to the lower edge of the shield protects the neck and chest. The full-vision face shield, which can be supplied clear or tinted, is trimmed with aluminium, and completely protects both front and sides of the head.

GAS WARMING OF LARGE BUILDINGS.—A second brochure on " Gas and the Warming of Large Buildings," dealing particularly with independent units, is the seventh book in the series on the commercial uses of gas published by the Gas Council, 1, Grosvenor Place. London, S.W.1, at 2s. net. This brochure gives advice on the choice of unit—flued or flueless ; heating by radiation or convection, or a combination of both ; overhead, wall mounted, floor standing or portable—according to the class of building, and the nature and use of the area which it is desired to heat.

OBITUARY.—We have noted with regret the death of Brigadier John B. Hickman, which occurred on June 3rd. Brigadier Hickman, who was fifty-four, was managing director of British Telecommunications Research, Ltd., deputy chairman of A. T. and E. (Bridgnorth), Ltd., and a director of Automatic Telephone and Electric Company, Ltd., and of Hivac, Ltd. We also regret to record the death of Mr. John Fletcher Miller, which occurred, at the age of seventy, on June 5th. Mr. Miller was the chairman and managing director of Fletcher Miller, Ltd., Hyde, Cheshire.

THE USE OF TIMBER.—As a guide for members of the timber trade, consumers, and for those responsible for the use of timber generally, the Kiln Owners' Association is issuing a comprehensive chart entitled " The Intelligent Use of Timber," which shows the moisture contents of timber for various purposes. The chart, copies of which may be obtained from the offices of the Association, 15, New Bridge Street, London, E.C.4, is reproduced by permission of the Department of Industrial and Scientific Research. We are informed that this kilning chart is part of a scheme introduced by the Association to make the value of timber kilning to industry more widely known.

GAS INDUSTRY MANAGEMENT COURSES.—The first course in management and general subjects, organised by the Institution of Gas Engineers, with the support of the Gas Council, opened at the Surrey County Council's Brooklands Technical College, Weybridge, on Monday, June 8th. The course, which is residential, is financed through a fund for the advancement of education in the gas industry, placed at the disposal of the Institution of Gas Engineers by the Woodall-Duckham Company, Ltd. There are fifteen students, twelve of whom come from area gas boards and three from firms in membership with the Society of British Gas Industries, most of them being at present employed in assistant technical or managerial grades.

INTERNATIONAL BUILDING COUNCIL.—An effort to develop co-operation in building research and methods is being made by the United Nations Economic Commission for Europe in Geneva at the end of this month. At that time Government and private experts from nearly all countries of Western Europe will meet to create an International Council for Research and Documentation in Building. They are also to discuss and establish a programme of work for the new organisation, to provide for international collaboration in experimental research, in studies and the application of the results of research, and in " documentation." The overall aim is " to promote progress in building and particularly housing by improving quality, reducing costs and increasing productivity."

THE SCIENTIFIC ADVISORY COUNCIL.—The Ministry of Supply has announced the following appointments to the Minister's Advisory Council on Scientific Research and Technical Development : Professor H. W. Melville, F.R.S., Mason Professor of Chemistry in the University of Birmingham ; Professor J. L. M. Morrison, Professor of Mechanical Engineering in the University of Bristol ; Professor L. Rosenhead, F.R.S., Professor of Applied Mathematics in the University of Liverpool ; Professor I. N. Sneddon, Professor of Mathematics at the University College of North Staffordshire, and Professor A. R. Todd, F.R.S., Professor of Organic Chemistry in the University of Cambridge. The council, under the chairmanship of Professor Sir Eric Rideal, F.R.S., advises upon important scientific and technical problems with which the Ministry is concerned.

Personal and Business

MR. LESLIE GAMAGE has been re-elected president of the Institute of Export.

MR. W. SCOTT WARNER and Mr. G. W. Richards have been elected directors of High Duty Alloys, Ltd., Slough.

MR. A. W. MCMURDO, A.M.I.C.E., has been appointed assistant engineer, London district, Western Region of British Railways.

MR. W. BULLOCH, A.M.I.Mech.E., has joined B.V.C. Industrial Constructions, Ltd., to take control of the hydraulic and mechanical materials handling department.

MONSANTO CHEMICALS, Ltd., Allington House, Allington Street, London, S.W.1, states that Mr. J. M. Kershaw has been appointed London development engineer.

JENOLITE, Ltd., announces the appointment of Mr. G. W. Robinson, 47, Ullswater Avenue, Acklam, Middlesbrough, as its representative in the north-eastern area.

BRUCE PEEBLES AND CO., Ltd., Edinburgh, announces that its works will be closed for the Edinburgh trades holiday from Friday evening, July 3rd, till Monday morning, July 20th.

THE VISCO ENGINEERING COMPANY, Ltd., Croydon, announces the retirement of Mr. F. Curt Smith, the chairman, who founded the business in 1921. Colonel G. Mallett has been elected chairman of the company.

BOLINDERS, Ltd., 4, Lloyds Avenue, London, E.C.3, states that, by arrangement with Nyqvist and Holm, Trollhattan, Sweden, it is able to handle inquiries for " Nohab " and " Polar Atlas " Swedish diesel engines and spares.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., states that Mr. A. R. Driessen, commercial manager of the Indian Cable Company, Ltd., has been appointed chairman of that company in succession to Mr. D. J. McIntosh, who has retired.

FLEXIBOX, Ltd., announces the appointment of Mr. K. W. Macnee, A.M.I.Mech.E., as technical representative in London and the home counties area. His address is 238, London Road, Twickenham, Middlesex (telephone, Popesgrove 1194).

CAPTAIN R. T. PAUL, R.N. ret., commercial manager of the equipment division of Mullard, Ltd., has been appointed a director of Telcon Telecommunications, Ltd., in place of Dr. D. B. Foster, who has resigned owing to pressure of work in other directions.

DEWRANCE AND CO., Ltd., states that it is opening, on August 1st, a new branch office for Wales at 6, Park Grove, Cardiff (telephone, Cardiff 29719), under the management of Mr. D. G. Seymour. The company also announces the appointment, as from August 1st, of Mr. L. Walker as its West of England representative.

THE MINISTER OF TRANSPORT has made the following highways engineering appointments :—Mr. J. F. A. Baker, M.I.C.E., deputy chief engineer (civil engineering), in succession to Mr. R. J. Samuel, M.I.C.E., who is retiring ; Mr. R. A. Lovell, M.I.Mech.E., deputy chief engineer, electrical and mechanical ; Mr. L. Cleaver, A.M.I.C.E., divisional road engineer, Wales and Monmouthshire ; Mr. T. E. Hutton, M.I.C.E., divisional road engineer, South Western division.

Contracts

CONTRACTS have been placed by the British Electricity Authority during the past month for power stations, transforming stations, and transmission lines amounting in the aggregate to £6,120,467. The principal contracts include :—Hackney power station, circulating water intake works (John Morgan (London), Ltd.) ; East Yelland power station, near Barnstaple, two 30MW condensing plants (G. and J. Weir, Ltd.) ; Goldington power station, Bedford, 3·3kV, 100MVA oil-break and 415V switchgear and accessories (A. Reyrolle and Co., Ltd.) ; Castle Donington power station, near Derby, 3300kV indoor airbreak auxiliary switchgear (British Thomson-Houston Company, Ltd.) ; Northampton power station, two 150,000 lb per hour stoker-fired boilers (Bennis Combustion, Ltd.) ; Hams Hall " C " power station, near Birmingham, main civil engineering work (Sir R. McAlpine and Sons (Midlands), Ltd.) ; Ferrybridge " B " power station, Yorks, one 100MW turbo-generator, feed heating and condensing plant (C. A. Parsons and Co., Ltd.), and access road and drainage, railway embankment and sidings, diversion of Fryston Beck, &c. (Chas. Brand and Son, Ltd.) ; Keadby power station, Scunthorpe, main and auxiliary cables (W. T. Henley's Telegraph Works Company, Ltd.) ; Wakefield power station, Yorks, reinforced concrete frames, roofs, floors, &c., for turbine house and service block (Holst and Co., Ltd.) ; Fleetwood power station, superstructure administration block and ancillary buildings (M. J. Gleeson (Contractors), Ltd.) ; Huncoat power station, Accrington, three 305,000 lb per hour boilers (Simon-Carves, Ltd.) ; Grove Road and Lodge Road substations, London, 66kV, 11kV, 6·6kV, and auxiliary cables (British Insulated Callender's Cables, Ltd.) ; Eynsham-Yarnton, Oxon., 132kV double-circuit line (W. T. Henley's Telegraph Works Company, Ltd.) ; Marchwood-Nursling, Hants, 132kV overhead lines (W. T. Henley's Telegraph Works Company, Ltd.) ; Castle Donington-Leicester, 132kV overhead line (Riley and Neate, Ltd.) ; Castle Donington-Toton, 132kV double-circuit overhead line (Riley and Neate, Ltd.) ; and Daventry-Rugby, 132kV double-circuit overhead line (Riley and Neate, Ltd.).

British Patent Specifications

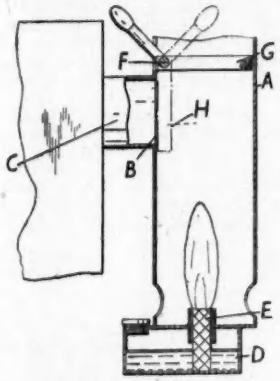
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. 8d. each.

INTERNAL COMBUSTION ENGINES

691,993. January 26, 1951.—STARTING OF INTERNAL COMBUSTION ENGINES, Ricardo and Co., Engineers (1927), Ltd., 21, Suffolk Street, Pall Mall, London, S.W.1, and John Forster Alcock, "Highlands," Ring Road, North Lancing, Sussex. (*Inventor: John Forster Alcock.*)

In the construction illustrated in the drawing, as applied to a four-stroke compression-ignition engine the apparatus comprises a vertical tubular inlet passage or chimney indicated generally at *A* having an inlet port *B* at an intermediate point in its length leading through the engine induction system, indicated generally at *C*, to the working cylinders. Arranged at the lower end of the inlet passage *A* is a burner comprising a fuel container *D* serving to feed a wick *E* projecting into the lower end of the passage *A*. Pivotally supported at *F* is a regenerative heat transfer device *G* extending across the passage *A* at a point immediately above the port *B*, or it can be moved downwards by a lever to extend across the port *B*. The regenerative heat transfer device may



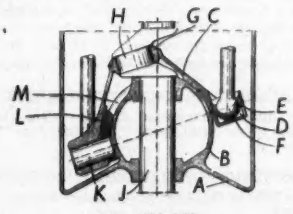
No. 691,993

be of various forms but in one satisfactory form comprises a circumferential frame carrying a number of superimposed layers of metal gauze of a gauge such as to give a high surface-volume ratio, the wire from which the gauze is formed having for example, a diameter such as to provide a surface area of at least 150 square inches per cubic inch of metal. In operation, when the engine is to be started the regenerative heat transfer device is moved into the position shown in full line and the wick is lit so that the device is heated by the products of combustion from the burner passing up the chimney. When this heating operation has been completed, for example, after a period of from 30 to 60 seconds, the device is moved into the position indicated at *H* and the engine is rotated in normal manner so that air is drawn through the heated device into the induction system *C* on its passage to the engine cylinders and is heated in a manner tending to ensure good starting. Designs are also shown in the specification for starting a two-stroke engine.—*May* 27, 1953.

POWER TRANSMISSION

692,148. January 9, 1950.—CONVERTING RECIPROCATING MOVEMENT INTO ROTARY MOTION, Marius Georges Henri Girodin, 20 Place de la Madeleine, Paris, France.

In the drawing the bottom of the casing *A* has a ball and socket joint *B* that serves as a bearing and a centering part for the gimbal or swivel piece *C*. This swivel piece carries at its periphery recesses *D*



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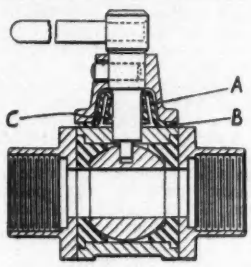
receiving the bearing balls *E* forming the top ends of the connecting-rods *F*. The member *C* includes a bearing *G* that is rotatably carried by an oblique crankpin *H* forming the crank of shaft *J*. The swivel piece *C* carries diametrically opposed trunnions *K* that are rotatably carried in slideway shoes *L* which slide in the grooves *M* of the ball and socket joint *B*. When the shaft *J* rotates the centre of the crank *H* describes a circle around the axis, the plane of the balls forming the top ends of the connecting-rods *F* remaining always perpendicular to the axis defined by the centre of the crank *H* and of the ball and socket joint *B* which is at the same time the axis of the member *C*, which is held fast against rotation by the system *K*—*L*—*M*. The angular setting of the plane of the balls *E* consequently varies with the rotation of the shaft *J*, resulting in a longitudinal displacement of the connecting-rods and pistons. An alternative design is also shown in the specification.—*May* 27, 1953.

VALVES

692,097. March 15, 1950.—SEALING A SPINDLE, Saunders Valve Company, Ltd., Grange Road, Cwmbran, Newport, Monmouthshire, and, Richard Hector Price, of the same address.

The invention provides for the sealing of the spindle and is especially applicable to plug cocks or valves. The valve spindle is sealed to the casing by a flexible double sleeve *A* of rubber-like material,



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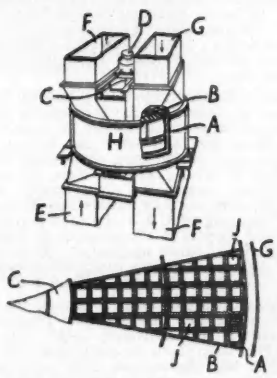
chosen according to the nature of the fluid. As shown, the outer end of the sleeve is formed with an integral flange *B* which is clamped to the casing. The inner part of the flexible sleeve which joints the outer part by a rounded bend is formed with an internal rib *C* at its free end, which normally grips the spindle sufficiently firmly to make a tight joint, though a binding or clip could be used as well if desired. *May* 27, 1953.

HEAT EXCHANGERS

691,986. November 27, 1950.—ROTARY REGENERATIVE AIR PREHEATERS, Aktiebolaget Ljungströms Angturbin, Nacka, Sweden.

The invention relates to an improved form of heat exchange material adapted for use in preheaters. Referring to the drawing, the cylindrical shell of a rotor *A* is divided into wedge or sector shaped compartments by radial partitions *B* connecting it with the rotor post *C*, which turns the rotor slowly about its axis. The rotor compartments contain regenerative heat transfer material which absorbs heat from gases entering the preheater through a duct *E* and



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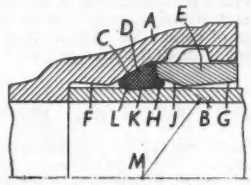
being discharged after passing over the heat transfer surface through an outlet duct *F*. Air is supplied through duct *G*. A housing *H* enclosing the rotor has at each end opposite sector plates apertured to permit streams of gas and air to enter and leave the preheater. In accordance with the invention the heat exchange surface is in the form of monolithic blocks or masses *J* such as ceramic tile or concrete with closely spaced parallel openings extending from end to end so that when mounted in the compartments of the rotor they constitute passages for the flow of gas and air with the openings extending parallel to the rotor axis. The openings through the monolithic blocks may be of any suitable form, as shown. A suitable material for the monolithic blocks is an acid-resisting tile made from a shale which produces a non-absorbing surface whose absorption rate is below 1½ per cent. Because such tile is of an alkaline nature, in the presence of acid burning flue gases no solid deposits form on the heat transfer blocks. It is possible to handle temperatures of 2500 deg. to 2700 deg. Fah. when employing ceramic tiles instead of metal plates.—*May* 27, 1953.

TUBES AND PIPE JOINTS

692,159. August 3, 1950.—PIPE JOINTS OF THE BELL AND SPIGOT TYPE, Koninklijke Nederlandsche Hoogovens en Staalfabrieken N.V., Ijmuiden, The Netherlands.

As shown below, the bell *A* of the left-hand tube receives the spigot end *B* of the right-hand tube. Between the spigot end and a conical surface *C* of the bell lies a rubber packing ring *D*, the ring being compressed by a pressure ring *E* having lugs co-operating with corresponding lugs of the bell. Between the diverging surface *F* of the bell and the spigot end some play is present, as well as between the surface *G* of the structure of the pressure ring *E* and the spigot end. By this means a relative movement of the tubes



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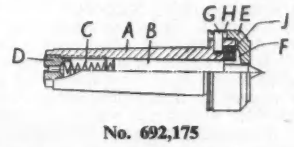
is possible, so that a pipeline may adapt itself to certain movements of the support or may be arranged in a curve. In order to restrict the relative movement of the tubes a locking ring *H* is used, co-operating with a sloping surface *J* of the pressure ring and a shallow groove *K* in the spigot end. In order to secure a good contact of the locking ring after a relative rotation of the tubes the surface *J* has the shape of a segment of a sphere, the centre of the sphere *M* coinciding with the centre of rotation of the joint. In the specification modified designs are also shown.—*May* 27, 1953.

WORKSHOP TOOLS AND APPLIANCES

692,175. July 17, 1951.—LATHE CENTRE, Wilhelm Wiest, Neckarstrasse 5, Plochingen (Neckar), Germany.

Referring to the drawing, *A* is a sleeve, in which is mounted a spindle *B* of a centre pin, so that it may be axially displaced in the sleeve. The spindle is forced towards the work to be centred and gripped by a spring *C* bearing against a screw *D*. The spherical inner surface of the cap *E*, the outer work-engaging surface of which is roughened, is adjacent to the outer surface of the slotted clamping bush *F*, the arrangement being such that the cap is freely supported by the clamping bush in such a way that it is automatically adjustable to work faces which are



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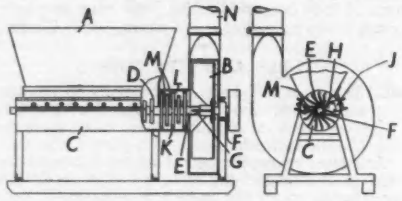
not perpendicular to the longitudinal axis of the work. Screws *G* on the sleeve *A* engage slots *H*, provided on the cap *E*, securing it against rotation with respect to the sleeve *A*. A recess provided in the front part of the sleeve houses the plate clamping springs *J*. The operation of the device is as follows. On clamping the work the centre pin *B* is moved rearwards until the face of the work is bearing against the cap *E*. Further displacement of the tailstock causes the cap *E* and the clamping bush *F* to act on the springs *J*, thereby diminishing their interior diameter. The resilient parts of the clamping bush then press against the spindle of the centre pin *B* to hold it in position. Modified designs are also shown in the specification.—*May* 27, 1953.

AGRICULTURAL ENGINEERING

692,125. May 6, 1951.—CHAFF CUTTING MACHINE, Friedrich Grieff, Im Fischtal 36*a*, Berlin-Zehlendorf, Germany, formerly of 99*f*, Westendallee, Berlin-Charlottenburg 9, Germany.

As shown in the drawing, the straw to be cut is fed to the chaff cutting machine through the hopper *A*. The blower *B* sucks the straw into the air channel *C*, where it is seized by the clawlike cutting blades *D*. These blades are fastened by screws on to the hollow shaft *E*, within which one end of the shaft *F* of the

blower *B* is supported. The two shafts are connected with each other by a safety coupling such as a friction coupling or a shearing coupling *G* and are driven together by the belt pulley. The cutting blades *D* coact with the stationary cutters or knives *H* like scissors fastened on a knife ledge *J*. The preliminary



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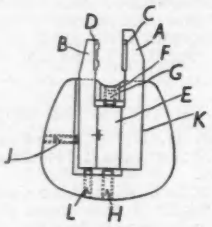
cut material is removed by suction and sucked through the fine-cutting or finishing device *K* arranged within the connecting piece *L*. A greater number of cutting blades is provided in the fine-cutting device than in the main cutting device. Besides, in the fine-cutting device a greater number of stationary cutters or knives is provided, namely, a series of cutters *H* and a series of cutters *M*. The finished material is then removed through the pressure pipe *N*.—*May* 27, 1952.

MEASURING DEVICES AND INSTRUMENTS

691,957. September 4, 1951.—MECHANICAL CALLIPER GAUGES, N. V. Philips' Gloeilampenfabrieken, Emmasingel 29, Eindhoven, Holland.

A gauge according to the invention is adjustable in a simple manner by unskilled labour. Moreover, it is re-adjustable to the desired measure in a short time. In the drawing the U-shaped frame has two measuring components *A* and *B*, each provided with hard metal measuring surfaces *C* and *D*. Fitted between the measuring components is a trapezoidal wedge piece *E* having three perpendicular sides and one converging side, which engages the measuring



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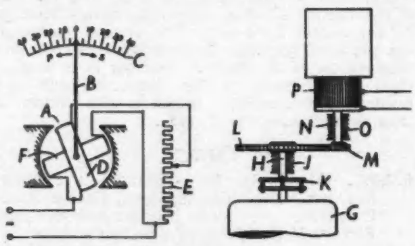
components beam *B*. An abutment stop *F* forming part of the frame comprises a screw *G*. At the lower side of the frame is a screw *H*, the position of the wedge piece *E* being determined by the two screws. By a screw *J* the assembly of measuring components and wedge piece is urged towards the right (in the drawing) against the surface *K* of the frame, the position of the measuring component *D* being determined by a screw *L*. It will be appreciated that the gauge has two means of adjustment. The component *D* is displaceable in a longitudinal direction with regard to the frame and the wedge piece by means of a screw *L*. The wedge piece is displaceable in a longitudinal direction by means of screws *G* and *H*, both movements changing the measure of the gauge due to the trapezoidal wedge piece. From the drawing it is seen that it is not necessary for the wedge piece to be machined very accurately to size. In mounting the gauge any dimensional discrepancies can be compensated for to a first degree of approximation by displacing this trapezoidal piece, thus obtaining the advantage of displacement of the measuring components being reserved for future re-adjustment of the gauge in service.—*May* 27, 1953.

MARINE ENGINEERING

692,241. October 25, 1951.—INDICATING THE POSITION OF A RUDDER, Erling Björnstad, 10, Bögaten, Oslo, Norway.

The invention relates to an improved apparatus which will, at any time, indicate the position of a rudder relatively to its middle position. According to the invention, a cross coil device *A* with pointer reading is used as the indicating instrument, the pointer *B* of which moves along a scale *C* having the zero position marked in the middle of it. In the first coil circuit *D* of the indicating instrument, which is connected to a source of direct current, there is placed an adjustable resistance *E*, the gradually increasing or decreasing resistance value of which causes a corresponding displacement of the pointer along the scale to the right or to the left respectively, provided the second coil *F* be supplied with constant current from the source as shown. The resistance *E* is so chosen that, when it is adjusted to the half of its value, the pointer will be at the middle point (zero) of the scale and when the whole value of the resistance is in the circuit or the resistance is completely switched out, the pointer will show 40 deg. port and 40 deg. starboard respectively. In order that the resistance *E* be adjusted according



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to the movements of the rudder, the rudder stock *G* is connected with a shaft *H*, mounted to rotate in a bearing *J* and arrangeed coaxially with the rudder stock. The connection between the rudder stock and the shaft is effected by a flexible coupling *K*. The upper end of the shaft *H* carries a toothed wheel *L*, which engages with a second wheel *M* fixed to the lower end of a further vertical shaft *N* mounted to rotate in a bearing *O*. The ratio between the gear wheels *L* and *M* is so chosen that the shaft *N* will make nearly a full revolution when the rudder stock is turned from one of its outer positions to the opposite one. To the upper end of the shaft there is fixed a rotary switch *P* having on its top a housing for the resistance *E*. When the rudder stock is turned its turning movement is transferred to the shaft *N*, so that the switch *P* is turned, thereby increasing or decreasing the value of the resistance *E* connected in the circuit of the instrument and so positioning the pointer *B* correspondingly.—*June* 3, 1953.

Launches and Trial Trips

CALTEX BAHRAIN, oil tanker; built by R. and W. Hawthorn Leslie and Co., Ltd., for the Overseas Tankship (U.K.), Ltd.; length overall 544ft 4in, breadth moulded 70ft, depth moulded 39ft 9in, deadweight 17,450 tons; twenty-seven cargo oil tanks, one pump-room, three Drysdale horizontal pumps, three Lamont vertical duplex pumps, Clarke Chapman steam deck machinery; single set of double reduction geared turbines developing 8200 s.h.p., steam at 450 lb per square inch and 750 deg. Fah. from two Yarrow water-tube boilers; two 400kW geared turbo-generators, two 50kW motor-driven generators, one 50kW diesel-driven generator. Trial, June 6th.

HARPA, oil tanker; built by Harland and Wolff, Ltd., for the Anglo Saxon Petroleum Company, Ltd.; length between perpendiculars 530ft, breadth moulded 69ft 3in, depth moulded 39ft, deadweight 18,000 tons; thirty-three cargo oil tanks, one pump-room, steam deck machinery; single set of double reduction geared turbines, 7500 s.h.p., steam supplied at 500 lb per square inch and 800 deg. Fah. by two Babcock and Wilcox water-tube boilers; two 550kW, 60 cycle, turbo-alternators, one 200kW, 60 cycle, diesel-driven alternator. Trial, June 11th.

CAMPOGE, passenger cargo liner; built by the Ateliers et Chantiers de France for the Messageries Maritimes; length between perpendiculars 488ft 1in, breadth 72ft 2in, depth to upper deck 43ft 10in, load draught 25ft 6in, load displacement 15,240 tons, deadweight 6580 tons; service speed 21 knots; 117 first-class, 110 tourist and 312 third-class passengers; six holds, MacGregor steel hatch covers, derricks include one 20 ton and one 50 ton; two sets of C.E.M.-Parsons geared turbines built by the Ateliers et Chantiers de la Loire, 19,500 s.h.p. in service; steam supplied at 880 lb per square inch and 900 deg. Fah. by three Velox boilers, four 700kW diesel-driven generators. Trial, June.

FORT DESAIX, banana carrier; built by the Chantiers de Provence for the Cie Générale Transatlantique; length between perpendiculars 344ft 6in, breadth moulded 51ft 6½in, depth to main deck 28ft 3in, load draught 21ft 4in, displacement 5900 tons, deadweight (banana) 1100 tons; service speed 15·5 knots; four holds and 'tween decks; Brissonneau et Lotz freon compressors; Burmeister and Wain ten cylinder, two-stroke, single-acting, diesel engine, 5250 b.h.p. at 131 r.p.m.; three 230kW diesel-driven generators. Trial, June.

QUEENSBURY, cargo liner; built by the Burntisland Shipbuilding Company, Ltd., for the Alexander Shipping Company, Ltd.; length between perpendiculars 430ft, breadth moulded 59ft 9in, depth moulded to shelter deck 39ft 3in, draught loaded 26ft 8½in, deadweight 10,650 tons; five holds, derricks include four 5 ton, six 12·5 ton, one 25 ton, one 50 ton; twin Gray Polar diesel engines geared to one shaft through hydraulic couplings and single helical reduction gearing, each engine has six cylinders 500mm diameter by 700mm stroke, total power 4315 s.h.p. at 110 r.p.m.; two Clarkson waste heat boilers, three 180kW diesel generators. Trial, June.

Technical Reports

National Building Studies Research Paper No. 12: "*Investigations on Building Fires: Part V, Fire Tests on Structural Elements*," D.S.I.R. London: H.M. Stationery Office. Price 15s.—Part V of the series of reports of investigations on building fires gives details of tests carried out by the Building Research Station on walls, partitions, columns, floors and beams over a period of ten years. It also includes a description of the equipment used at the Fire Testing Station at Elstree, where the tests were made. Based on the results, fire resistance gradings for several typical forms of construction are suggested in the main text. The results of over 200 tests follow, in the form of data sheets. Each sheet gives details of the structural element under test, the temperatures reached at various points within it and its general behaviour when subjected to the standard test.

Books of Reference

Water Engineer's Handbook, 1953. London: The Colliery Guardian Company, Ltd., 30 and 31, Furnival Street, Holborn, E.C.4. Price 18s.—This well-known reference book, compiled by the staff of *Water and Water Engineering*, follows in this edition the familiar layout of earlier years, with a directory of water undertakings in the British Isles, occupying a large share of its pages. There is also information about river boards, relevant Government Departments, and technical institutions, British Standards applicable to water engineering, and other information on water supply, including statistics of the various undertakings listed in the directory.

English Rock Terms. By W. J. Arkell and S. I. Tomkeieff. London: Oxford University Press, Amen House, Warwick Square, E.C.4. Price 21s.—It is pointed out in the preface to this work that every craft has its specialised vocabulary which is often rarely recorded and sparsely recognised in literary use. There are still in use to-day in mines and quarries many terms that have become obsolete in ordinary spoken language. Such of these terms as relate to various kinds of rock and strata have been collected together in this dictionary, with some notes on their etymology. Scientific names ending in -ite, scientific or other names based on place-names or on fossils, and terms belonging to the vocabulary of mineralogy, and most of the names of the individual coal and ironstone seams have been omitted. The resulting collection of rock names—some peculiar to a locality or a particular craft—are of no small interest. Many civil engineers will be acquainted with some of the seemingly odd local rock names—such as "grizzle," "shoad," "puddingstone," &c.—collected in this glossary.

Catalogues

NEWMAN INDUSTRIES, Ltd, Yate, Bristol.—Brochures giving details of larger output motors and range to the draft B.S. CN (ELE).

PRIESTMAN BROTHERS, Ltd., Holderness Engineering Works, Hull.—Publication No. 69,253, "The Priestman System of Grab Dredging."

ABBOFLEX, Ltd., Ferry Road, Teddington, Middlesex.—Pamphlet describing "Abcon" conduit coupling and "Abconflex" flexible conduit.

DOMINION RUBBER COMPANY, Ltd, 62 and 64, Horseferry Road, London, S.W.1.—Catalogue and handbook of conveyor and elevator belting.

COLLOIDAL GRAPHITE, Ltd., 6 and 7, St. Dunstan's Lane, London, E.C.3.—Brochure dealing with "Susgra" colloidal graphite products.

BAILEY METERS AND CONTROLS, Ltd., Progress Way, Croydon.—Catalogue illustrating air-operated combustion control for oil and gas-fired boilers.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ILLUMINATING ENGINEERING SOCIETY

Fri., July 10th.—NOTTINGHAM CENTRE: The University, University Park, Nottingham, "Midlands Area" Summer Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., June 29th. to Fri., July 3rd.—Summer Meeting, Newcastle upon Tyne.

INSTITUTION OF PRODUCTION ENGINEERS

Thurs., June 25th.—WOLVERHAMPTON GRADUATE SECTION: Star and Garter Royal Hotel, Victoria Street, Wolverhampton, "British Watch and Clock Production," R. Lenoir, 7.30 p.m.

Thurs. to Sun., June 25th to 28th.—BIENNIAL CONFERENCE: Harrogate, theme of the conference "Production for Plenty."